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THE CULT OF WAIET IN THE MURRAY ISLANDS, TORRES STRAITS.

BY A. C. HADDON, SC.D., F.R.S.

I HAVE given in vol. vi, pp. 277-280 of the "Reports of the Cambridge Anthropological Expedition to Torres Straits," Cambridge, 1908, all the information then available about Waiet of Waier, the smallest of the three Murray Islands. Through the kindness of Mr. Heber A. Longman, Director of the Queensland Museum, Brisbane, I have received a most interesting description of the hitherto unrecorded cult of Waiet (accompanied by sketches of the effigy), written expressly for me in response to a request by the Director by Mr. A. O. C. Davies, formerly the schoolmaster on Mer and now in charge of a State school at Kalbar, S. E. Queensland. Mr. Davies collected the very fragmentary remains of Waiet and presented them to the Queensland Museum.

I have transcribed, with minor unimportant omissions and modifications, the account sent to me by Mr. Davies, and have clearly indicated my own remarks.

Waiet lived at Mabuiag with his wife Weiba and their only daughter Gainau. Every day he went to the waterhole on the chance of meeting women or girls who came to draw water. On meeting some he would probably select one and have intercourse with her; if he was in a contrary mood he might order his attendant *zogo-le* or *tami-leb* to cut off the girl's head.

One day, feeling indisposed, he did not go for his walk, but the *zogo-le* and *tami-leb* went as usual. On the way they met Weiba and Gainau and, being determined to emulate Waiet, seized and had intercourse with them and, moved by jealousy, cut off their heads.

On hearing the news, Waiet decided to take his drum and leave Mabuiag, and, crying and beating his drum, went to Nagai. The island of Nagai was not satisfactory, as his drum did not sound well, so he departed and came to Oidol. His drum did not sound well here, so he went to Mer. Like Malu, he went round the island and stopped at Kapeub on the other side, but as there was no suitable harbour it was "no good sitting down."

Hearing that Malu was in possession of Mer, he took a canoe and went across to Dauar. He landed at Giz, but the land was straight and did not appeal to him, so he went to Ouzes, at the sandspit called Teg. This was "no good," so he went across to Waier and, skirting the northern coast, came to the harbour on the eastern side called Nay (this is pronounced slightly differently from *Nee,* drinking water) [we write this word *ni* and the bay *Ne*]. At the head of the harbour is a nice beach of sand and pulverised pumice-stone, behind which a cliff rises to about 150 feet in height. This he climbed, and sitting down on a ledge of rock began to beat his drum. The sound echoed from the semicircle of cliffs, and pleased with the place he determined to settle there.

He again beat his drum, but more loudly than before, and began to sing. Two women, Dumieb [these are the *au kosker* "old women," Reports, vi, p. 279, pl. v, fig. 2], down at the point, heard him and began to dance. Waiet then took some yellow sprouting coconut palm leaves and put them round his head [Reports, iv, p. 35] and beat his drum still louder and sang. The two women approached him and he sat down on some coconuts (because of this the turtle-shell effigy of Waiet was placed in a sitting posture on some coconuts). When the women came up to him he had connection with them and said that he would abide there as it suited him. He micturated from the top of the cliff, which accounts for the large lagoon and the abundance of fish in it.

The cult of Waiet thus took its rise, it being the emblem of fertility of mankind, the coconuts denoting abundance of fruit and the lagoon of fish an abundant supply of fish for food.

[The *Nagai* of Mr. Davies is *Nagir, Oidol* is probably *Widul,* but if so the order of Waiet's journey has been inverted. I also was informed that the arrival of Waiet at Mer was subsequent to that of Malu.

I obtained three versions of the story of Waiat, as he is called by the Western Islanders. In the Tutu version (Reports, v, p. 48) Naga and Waiat (who acted as "crew" for Naga) went from the Katau River (Binaturi) (143 deg. E. long.) to Yaru (Daru) where they performed a death-dance, *markai,* and taught it to two Tutu visitors. Naga went to Augar [Uga] and showed the people there how to "make *markai,*" and later settled at Tutu. In the Nagir tale (v, p. 49), Naga was a resident at Nagir who instructed the men how to make masks in the form of animals, *urui krar,* and taught them the songs and dances and everything relating to the *kwod,* and how to "make *taiai,*" or funeral ceremonies. Waiat of Mabuiag came to Nagir to learn how to beat the drum, and Naga taught him. Then Waiat stole a famous mask. The Mabuiag story (v, p. 49) is much longer: There was a woman named Kuda who had two boys; they, Waiat (or Naga or Izalu) and some other people, lived on Widul, a small island off Mabuiag (I have an additional note that Kuda taught everybody how to make an earth-oven, *amai*). Kuda dressed her boys up and taught them to dance. Waiat used to play by himself, hauling up and letting down a *goa* rattle (v, p. 50). [This performance resembles an incident in the

uruba ceremony of Kiwai described by Riley (1925, p. 236). The *uruba* is a kind of memorial service for the dead and a farewell to the spirits of the dead who were returning to their home in the west.] Once Waiat went to the Fly River and thence to Mer. Waiat persuaded the woman to put the boys under his care that he might instruct them in dancing. He heard a drum sounding, and in order to find out about it went first to Badu; he was sent on to Moa and thence to Nagir. Arriving at Nagir he went to the *kwod* and saw some theriomorphic dance masks; he went behind the *waus* (v, pl. xix, fig. 2) and saw a *debu* (king-fish) mask. He then went to the village and persuaded the men to show him everything, and he commandeered the *debu* mask and took it to Gumu on Mabuiag. One evening Waiat sent the women to get some water, but Goinau his wife, and their daughter Wiba, refused to go. Waiat had previously sent some men to fetch the mask from Gumu to Widul, and evidently Goinau and Wiba saw what the men were doing. The women came back with the water, and Goinau and Wiba then went to get water. Waiat said to all the men, "If any man meets any woman in the bush he must kill her, for by-and-by the women will talk in the house about what we have been doing." The men went along the road that the two women had taken and met them. The men said Waiat had told them to kill anyone they met and they would have to kill them, so they cut off their heads. On their return Waiat was informed of what had happened, and then felt very differently about the matter. In the middle of the night he killed his "mate," Manari, and the two brothers. Next morning before sunrise, as her sons were not dancing as was their wont, Kuda came to Waiat's house and asked the men to wake up her sons, but they found them dead under their mats. Kuda upbraided Waiat, who swore at her. Then her folk came; some hauled Waiat this way and some hauled him that way, and they broke his limbs, and cut off his arms at the elbows and his legs at the knees; and Waiat cried, "Please leave me alone; I am a big place, I am like the sun and the moon. Every place knows me. Leave me alone. *U, u, u, u.*" They gouged out his eyes, cut off his ears, plucked out his whiskers, tore out his lower jaw, and he moaned "*U, u, u, u,*" till he died. They took off all his black skin and rolled him about like a cask till the raw meat alone was left and he looked like a white man. It is not at present possible to co-ordinate all these various stories.]

Pasi told Mr. Davies that he was the only white man who had seen Waiet; his seeing the remains and collecting them caused considerable consternation, and for three nights he was apprehensive of his own safety, Barsa coming along at daylight to see if he were still alive.

The effigy of Waiet was in a recess of a ledge of the cliff of Waier about 150 feet above sea-level. Below this was another ledge with a number of recesses containing numerous clam-shells, which had been used for cooking purposes, and the marks of fires were still visible in several of the recesses. There were

also some small clam-shells painted with red earth, and a number of the shells which are used by the natives for scraping coconuts; these were also painted red and were held in the mouth during the ceremony.

As no ceremonies had taken place since the coming of the missionaries, the effigy had fallen into disrepair, owing to the decay of the coconut-string fastenings.

The effigy represented the head and trunk of a man, and was about 4 feet high. It had no legs and squatted on a heap of coconuts, and was made of pieces of turtle-shell neatly sewn together with coconut line. A *wangai* stake passed through the effigy and held it upright, and another stick at right angles to it supported the outstretched arms. The face was made from a large piece of turtle-shell with a border of finely carved chevrons. There was a *dari* of tern feathers which had been dipped in a mixture of blood and red earth. The mass of hair contained remains of organic tissue. Around the forehead was a string of rib-bones painted with blood and red earth. Pasi said that they were those of a white boy, but he would not say why he was killed. Around the neck hung a string of human rib-bones, also painted red, and above this a crescentric pearl-shell, *mai*. Around the waist was a string of arm and leg bones, and below this a groin-shell *ebnoa* [*eb enoop* or *ebeneaup*]. A string of white cowry shells (the large sacred ones) [*bubuam, Amphiperas ovum*] was suspended from each shoulder and hung down in front to the waist; while down the back hung two strings of small white cowry shells painted red and joined together in the middle by a jawbone, apparently that of a young person; this was the only jawbone attached to the effigy, and in this it differed totally from the Malu mask. Both arms were extended level with the shoulders, with the palms upwards. On the left forearm was a carved turtle-shell bracer or arm-guard, *kadik*, and under the left upper arm was hung a *gabagaba* (stone-headed club) with a triangular stone head, but the handle had rotted. Under the right arm was a basket, which also had rotted. In front of the effigy were several clam-shells.

[Mr. J. Bruce, formerly living in Mer, had a model made of Waiet which he presented to the Cambridge Museum. It is described and figured in the Reports (vi, p. 277, pl. xxii, fig. 6), but it bears no resemblance to Mr. Davies' description and sketch, so it must be regarded as worthless. Mr. Bruce said that round the brow of the original was a headband to which were fastened the ribs of men and women, *eud lera bir lid*, "dead men's ribs." In the model there is a necklet of three wooden pendants in front and one behind; these represent the pieces of bamboo and bones of dead people of the original; these rattled with a peculiar noise wherever he went. Mr. Bruce also presented to the Museum a model of the *sal* or *sale* (railings of the platform of a canoe) which formed the shrine of Waiet (l.c. pl. xxi, fig. 1).]

The Waiet ceremonial took place annually and lasted for eight days. No women or children were allowed to be present, and any woman who was caught trying to look at Waiet was immediately killed, or, if the ceremony was to take place in the near future, she would be kept to form one of the sacrifices.

At the time of the ceremonial all the families concerned went over to Dauar, where they camped. The men then formed a procession, and with the novices, captives, and a supply of food crossed over to Waier; the evening was spent in making preparations. The three *zogo-le* and the three *tami-leb* had come over previously, and, while the *tami-leb* cleared away any vegetable growth about the two ledges and gathered fresh coconuts for Waiet to sit down on, the *zogo-le* repaired any part of Waiet that needed attention. The *tami-leb* were also responsible for cleaning the clam-shells, bringing coconut oil and turtle grease for the anointing of Waiet, and preparing the vine rope used for hauling the captives up the cliff.

The next day the *zogo-le* took Waiet out of his recess and set him on the coconuts. Two *zogo-le* took up their position on either side of Waiet, and the *tami-leb* sat on the ledge below, and at the command of the chief *zogo-le* began to beat their drums, then the chief *zogo-le* danced. Everyone held in his mouth a red-painted shell, and instead of singing said, "Ha-ha, Ha-ha." The men below formed a grand procession; all who held office of any description came first with the regalia, then followed the novices, next the captives, and the last year's initiates formed the rear.

When the procession was over, the captives were placed under a guard. Then followed the presentation of peace offerings, and next the novices were brought forward to the foot of the cliff and were duly initiated. (Pasi would not tell Mr. Davies what took place, but denied that circumcision was a part of the ritual.) The young men were next taught the appropriate dances and songs.

The new initiates were taken to the place where the fire was to be made, then brought back, and hot coals from the sacred fire burning in front of Waiet were lowered down the cliff in a clam-shell by a vine. Each initiate was given some of the sacred fire, which he placed in a coconut shell, and then they were marched back to the cooking place, where they solemnly lighted the big fire to be used for cooking. It was their duty to see that this fire was kept ready for use, and also to get a supply of fuel. The captives were then divided into five groups, one for each day. They included prisoners exchanged for others from Erub or from New Guinea so as to avoid eating more relatives than they could help, men who had done wrong, and women who had been caught trying to look at Waiet.

The chief *zogo-le* ordered a tattoo of the drums, and then cried out, "Prepare the sacrifice!" The day's quota of captives was brought to the foot of the cliff and the *zogo-le* ordered that he (or they) should be cleansed. A captive was taken down to the water, scrubbed with pumice stone, and washed in the sea. Then he was taken to the foot of the cliff, fastened to the vine rope, and hauled up the cliff. The *zogo-le* marked off with lime on the body of the captive the portion each desired, and the *tami-leb* did the same. (The part most relished was the *susu*, breast of men, and the muscle of the arm; the *susu* of

women; but no particular part of children. By the way Pasi described it, he must have been very fond of it, having previously said that "man-meat tastes much sweeter than pig-meat.")

The chief *zogo-le* then described the cult of Waiet, and explained that it was essentially to promote human fertility, and in order that the concluding ceremony should be effective Waiet demanded a sacrifice first. As it was not seemly for the god to go to them, they must come to him and exhibit themselves for his inspection. (Pasi did not say whether Waiet ever rejected a sacrifice.)

The *tami-leb* then laid the bound captive in front of Waiet, the chief *zogo-le* took a bamboo knife, cut off the sexual organs, and placed them on Waiet's extended palm; a small clam-shell caught a certain amount of the escaping blood. The chief *zogo-le* killed the victim by striking him on the head with Waiet's stone-headed club. The marked portions of flesh were cut off, and the remains were lowered down the cliff and taken to the fire to be cooked.

If there were two or three captives in that day's quota, the sexual organs of the previous victim were taken from Waiet's hand and placed in the basket under his arm, and after the last victim had been killed the organs were placed on top of Waiet's head. When all the victims had been disposed of, Waiet was replaced in his recess in the cliff, and the *zogo-le* and *tami-leb* cooked their portions on the lower ledge. The other men laid coconut and banana leaves on the ground, on which the portions were served out.

The *Oour* [*aua* is primarily a term for mother's brother, but is given to all men of the mother's village of the same generation as the mother. Pasi belonged to Giar pit, the westerly point of Dauar, and his mother, Wam, belonged to an important family at Er; she had two brothers, Charlie and Maiwas, who died unmarried. There were close relations between Er and Dauar] or uncle of Pasi, carried a feather of a *gawei*, a big black and white bird (spoonbill) in each hand. The men beat the drums but did not sing, while the man with the feathers danced round the fire and, having chosen the portion he preferred, sat down in front of it. The other men, according to their age, seated themselves before the portion each fancied, the initiates, of course, coming last.

After the feast the time was devoted to special dances. In one dance the men held, in a throwing position, three-pronged spears made of hard wood from the Cape York peninsula. Another dance was performed with a dugong bone hung from the neck. In another, something was tied round the head, and the tongue painted red with *mair* (this is a yellow ochre that comes from New Guinea and, when roasted, turns red); the man danced with his tongue protruding, and the men sitting in lines held their hands palms outwards, up level with their shoulders, and kept time with drums, saying "Ha-ha, Hoo-hoo!" In another dance a man wore a turtle-shell mask of a "barracouta," the open mouth of the fish being in front and the tail behind. [This may be in reference to the mask taken by Waiet from Nagir, which I was told represented a king-fish,

Cybium commersoni, the *gagai* or *debu* of the Western Islanders, and the *geigi* of the Miriam; cf. Reports, v, fig. 7, p. 54.] One dance, which belonged to Sagare (Tom Sergeant's father), was performed with beautifully carved bamboos on the fingers; the hands were held up, palms outwards and level with shoulders; the song, according to Pasi, was about a mother calling for her lost son. The songs and dances belonged to particular families, and could be performed only by members of the respective families. The office of the *zogo-le* and *tami-leb*, and *Oour* [?] was hereditary in the male line. It was usual for the eldest son, who would take that office, to have his wife chosen for him, so that the family should be kept very select. Pasi tells how his wife was chosen for him by his two uncles, as his father had died when he was about twelve years old.

After dancing the men went to rest in crevices in the rocks, as no houses or buildings were allowed to be erected; even now there are no houses on Waier.

The foregoing incidents occurred on each day of the ceremonies, and on the eighth day a farewell dance was performed before Waiet, who was then finally restored to his recess. The *zogo-le* and *tami-leb* descended the cliff and supervised the covering of the fire with sand. It was believed that, if anyone desecrated the beach of Ne by bringing a canoe there, Waiet would cause this fire to burn the canoe. A man did once bring a canoe there, and it was burnt—probably by his accidentally dropping a live coal when he got out of the canoe.

The procession then reformed, led by the *zogo-le*, *tami-leb*, and *Oour*, and to the solemn beating of the drums the men responded "Ha-ha, Ha-ha," as they marched round the island and crossed over to Dauar.

The women meanwhile had prepared a big feast for the concluding ceremony; fish, turtle, yams, sweet potatoes, coconuts, bananas, &c., were all ready and were placed on leaves on the ground so as to form an oval, at which the *zogo-le* sat at one end and the *tami-leb* at the other. The number of females present always exceeded that of the males, and included every female over the age of about twelve belonging to the Waiet fraternity, none being permitted to be absent.

By the time the feast was finished it was getting late in the afternoon, and the chief *zogo-le* stood up and explained to all present the significance of the cult of Waiet and its importance in maintaining the fertility of mankind, and how by means of the remaining part of the ceremony all the barren married women would have the opportunity of becoming productive.

The chief *zogo-le* then chose for himself the most favoured girl, the other *zogo-le* and the *tami-leb* in their order, followed by the *Oour*, selected their partners. Then at the signal of the chief *zogo-le* the men, with the exception of the initiates, rose up and seized any woman or girl they could, after which the initiates were allowed their choice of what was left. This license was permitted

for that one night only, and at sunrise next day all went to their own families, and any excess afterwards was punishable with death.

[The foregoing account of the cult of Waiet by Mr. Davies presents some features that are of great interest and were previously unknown to occur in Torres Straits. The more important are that it was a ceremony to ensure human fertility, and that cannibalism and promiscuity were an integral part of it.

A parallel may be drawn between the cult of Waiet and the big *Nogo* at Melpmes in the Newun district of Malekula (A. B. Deacon, MS.), the object of which was "to make men"; it ended with a rite of promiscuity, and was associated with a culture-hero named Ambat; but there is no need to go so far afield.

The *Moguru* of Kiwai is described by Landtman (The Kiwai Papuans of British New Guinea, 1927, p. 350) as the Life-giving ceremony and as being the most secret, sacred, and awe-inspiring ceremony of the Kiwai people. The *maure moguru* is particularly connected with the fertility of the sago-palms, and also serves to add to the strength and vitality of the people; promiscuity is indulged in, and it ends with the death of the old couples who conducted the rites. It is not stated how they die, nor is there any hint of cannibalism. But there does not appear to be any direct connection between the cult of Waiet and the *moguru*.

With regard to cannibalism, W. N. Beaver (Man, xiv, 1914, No. 74), in "Some notes on the eating of human flesh in the Western Division of Papua," says that "a long experience of almost every district of British Papua makes me incline to the view that, while ritual or ceremonial does in many instances form the prime reason for cannibalism, in by far the greater number of cases human flesh is eaten because it is a food and is liked." He adds: "Even at a village like Parama, at the mouth of the Fly, a native of the tribe told me that in his grandfather's time men were eaten. I am inclined to think that among the Kiwai-speaking tribes the same practice was not unknown. . . . From the western bank of the Fly eastwards it seems that in the case of a male the penis, and in the case of a female the vulva, were always cut out. These portions were used for various purposes."

Very little is known about the natives living between Mawata and the Netherlands boundary, but P. Wirz (Die Marindanim von Hollandisch-Sud-Neu-Guinea, Bd. ii, Teil iii, Hamburg, 1925) says that the Marind (who are known as Tugeri in British territory) state that three of their important cults came from the eastern area beyond the boundary. These are the *Mayo, Rapa,* and *Sosom;* the latter is a bull-roarer cult in which a monster is supposed to swallow novices. The *Mayo* is a typical annual initiation ceremony with instruction of the novices of both sexes in everyday occupations; finally admission to sexual life is celebrated by an orgy, in which it appears that cannibalism was also a

feature; the coconut is the cult object. The *Rapa* is a fire cult (and probably also a pig cult) of the fire-cassowary group with sexual excesses and cannibalism. Cannibalism and promiscuity also occur in the *Imo* cult and in the *Ezam* cult in the interior.

The traditional origin of the Waiet cult from the western part of British New Guinea is thus substantiated, as it is in agreement with analogous cults of that region. The only difficulties are—(1) that no indication was given to me in Mabuiag of the sinister aspects of the cult, but this was doubtless from prudential motives, and the same occurred in Mer, for though, as described to me, the cult there was essentially of an erotic character, the cannibalistic phase was hidden from all investigators, till Mr. Davies had the good fortune to discover it; (2) in Mabuiag, Waiat was said to be the head or chief of the *tai* or *markai*, the death-dances that were held on Pulu, a sacred islet off Mabuiag, and during these the people "thought about what Waiat did," and all the women were frightened, I could not discover why. (Reports, v, p. 252.) There was a wooden effigy representing the mutilated, legless Waiat in a house on Widul, which only the old men might see; whenever they built a new house for Waiat some of the men dressed up as *zarar markai* and danced; this dance was also performed at Widul and Gumu three days after the ordinary *tai* ceremony.

Waiet is stated to have introduced to the Dauar and Waier people various *keber*, funeral ceremonies, so these people claim to be the *giz ged*, "original places" of the *keber*. The Dauar and Waier people in turn instructed certain groups of people on Mer; for example, Waiet taught the Dauar people the *zera markai keber;* they gave it to the people of Sebeg (Kòmet *le*) and Er (Geaurem *le*) on Mer, and in course of time ceased to practise it themselves; so, when a Dauar or Waier man died, the Er people received a fire-signal and went over in their canoes to perform the *zera markai keber*. According to another account, Waiet gave it to the Kòmet *le*, but the Geaurem *le*, whose headquarters were at Er on the south-east side of Mer, brought it independently from Mabuiag. (Reports, vi, p. 128.) The *zera markai keber* was performed while a corpse was yet unburied (Reports, vi, p. 133), and it is acknowledged to be the same as the *zarar markai* of Mabuiag (v, p. 253; iv, fig. 249, p. 289); the drummers sang, not in the Miriam language, but corrupted words of the Western language.

In my final volume of the Reports, I shall again refer to this cult, and possibly may then be able to clear up some points which are at present obscure.]

THE VENOM APPARATUS OF THE STONE FISH (*Synanceja horrida*).

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(Text-figures 1-8.)

A considerable amount of work has been done on the secretory activity of the skin-glands of fishes. Most of the work, however, is morphological and descriptive, and remarkably little observation has been made of the function of these glands, and still less of the effect of their secretion.

Of all the works consulted, that of Reed[1] is in its way the most complete. He has made a very careful study of the histology and development of the dermal glands of a large number of species of fishes reputed to be poisonous. He provides also a very complete bibliography, and his paper is a masterly summary of the subject. To this paper a good deal of reference will further be made.

Citterio[2] gives an excellent morphological study of *Ameirurus catus*, and the authors of this paper in general confirm his histological findings.

Muir Evans[3] traverses the literature dealing with the defensive spines of fishes, and gives some observations on the nature of the venom apparatus of *Trygon pastinaca, Acanthius vulgaris* (spiny dog-fish), *Cestracion philippi* (Port Jackson shark), and *Chimæra monstrosa*. He says, "In this country very little original work has been done on the subject of defensive spines of fish." He notes that down to the time of Cuvier little evidence existed that fish secreted a poison. The naturalists up to that time believed that the lesions produced by fish-spines were traumatic rather than toxic. Alman (1841) then "described a gland at the root of the spine of the lesser Weever. His discoveries were widened and confirmed by Byerley, Gunther, Bottard, and others" (Evans).

Bottard[4] (1889) described the poison apparatus of *Synanceia* (*sic*), but as his paper is inaccessible we have no means of knowing whether he actually confirmed by experiment his assumption that the dorsal spines he described secreted a poison.

Gunther in his book devotes a few lines to *Synanceja*, and accurately figures the poison gland of the dorsal spines, though later Starr Jordan makes the mistake of surmising that the poison gland of this species is to be found at the base of the spine.

The following paper is a preliminary study dealing with the osteology, myology, and histology of the venom apparatus of the dorsal spines, along with some observations on the toxicology of their secretion. Abundant evidence is brought to show that the sacs lying along these spines do secrete a substance which is highly toxic to laboratory animals.

Stimulated by Reed's work, a histological study was also made of certain skin organs likely to be incriminated as venom producers. Histological study was made of certain portions of the skin, the results of which are similar to those obtained by Reed, but this part of the work is far from complete from the toxicological aspect, and it is hoped to supplement it at a later date. [We have since shown that the secretion of the broad tubercles differs from that of the dorsal spine sacs.]

The reason for this is that (i) it is difficult to obtain living material, (ii) it is more difficult still to obtain sufficient skin secretion under laboratory conditions to produce experimental effects, though it will be shown that there is a probability that this difficulty is more apparent than real.

The present study deals, therefore, primarily with the sacs of the *dorsal* spines of *Synanceja horrida*, and for the first time certain physiological and serological findings are produced in support of the view that these sacs secrete a poison. The purely descriptive parts of this paper were worked up from two specimens supplied by Mr. H. A. Longman, Director of the Queensland Museum, and the toxicology from a specimen supplied by Dr. F. G. Power, by courtesy of the master of the s.s. "Bombala."

Description.—Macroscopic:—The measurements of the four specimens examined are:—

Reference.	Length.	Head.	Tail.	Height.
	cm.	cm.	cm.	cm.
Q.M. I/2217	30	8	5	9
Q.M I/1193	24	7·5	4	8
B.L. F/I	24	7	4	8·5
B.L. F/II	34	11	5·5	..

B.L.F/II showed certain marked variations from other specimens examined. See Appendix.

In all specimens the dorsal fin consists of 14 spines, 13 of which can project beyond the enveloping skin, and one, that between the tail and the next spine cranially, is completely enveloped by skin, and apparently unable to exert any defensive function.

Thirteen spines therefore, though normally well covered with skin, can readily be exposed along a short portion of their length. Reed remarks (*loc. cit.*) : "In the Scorpenidæ and others the spines are naked in the distal portion and are so related to the gland and surrounding integument that there is formed a mobile sheath, which easily slips away from the apex of the spine. . . . Thus the spine is not only free and inflicts a wound without injury to itself or surrounding tissues, but is freely supplied with venom. Such an apparatus is probably to be construed as none other than a defensive device." This is exactly the opposite to the condition common to the catfish, in which the spines are so completely covered with integument "that when inflicting a wound it is necessary for the spine to first puncture the skin which covers it."

The skin of the stone fish, though covering the spines, has no attachment to them above 0·5 cm. from the tip. From a point 0·5 cm. from the tip of the spine to within about one quarter of the length of the spine from the articulation with the interneurals, the skin is attached to the spine. The attachment of the skin is very firm and fibrous, lying in shallow grooves on either side of the spine until just above the articulation with the interneurals, where the attachment is complete all round the spine.

On dissection we found a muscle in the superficial fascia, fibres of which ended dorsally along the spines at the junction of the middle and distal thirds of the spine. This muscle was traced to an origin on the occipital region of the skull where it is 3 cm. broad in average specimens. From there it extends along the dorsum, keeping the same width until on either side it reaches a point opposite the 12th spine, where it spreads out fanwise to be inserted into the dense fascia about the base of the anal fin.

This muscle is evidently for the purpose of retracting the skin over the spines—"a *panniculus spinæ.*" It has no connection with the intrinsic muscles of the vertebral column, since its fibres run at right angles to them.

Dissected from their skin attachments, we find that the spines are loosely articulated with the interneurals.

In specimen Q.M.I/1193, we found the spines to measure as follows (measured from tip to articular surface) :—

	I.	II.	III.	IV.	V.	VI.	VII.	VIII.	IX.	X.	XI.	XII.	XIII.	XIV.
Centimetres	2·25	3·25	3	2·5	2·7	2·8	2·8	2·8	2·9	3	2·8	3	3·3	3·6

With the exception of the first, all the spines are of the same form—at the articular end fairly expanded into lateral condyles and tapering to a fine point at the distal end. Between the condyles the bone is perforated for the purpose of articulating with a ring on the interneurals. Along the lateral aspects of the spines are shallow grooves continuing almost to the tip. The first spine has greatly extended condyles which end laterally in a rather sharp point. (Fig. I, E, 1st spine; F, 2nd spine.)

The spines articulate with the interneurals by a semicircle of bone on the dorsal aspect of the interneural passing through the perforation of the spine between the condyles. (Fig. I, A, lateral aspect; B, cranial aspect; D, dorsal aspect.)

The first and second interneurals are fused, all others are separate. Each interneural is roughly rectangular or rhomboidal in shape, and along the lateral aspect of each is a median ridge. (Fig. I, C and A.)

Text-figure 1.—1st and 2nd dorsal spines of *Synanceja horrida* and their articulation with interneurals.

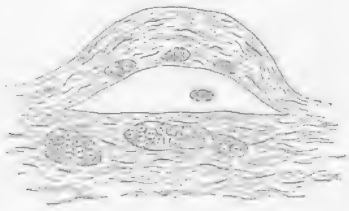
Along the interneurals laterally run two muscles, one cranial and one caudal, to the median lateral ridge. The lateral muscle cranial to the ridge arises on the ventral and cranial aspect of the condyle of the spine, while that caudal to the median ridge arises from the dorsal and caudal aspect of the lateral condyle. Both muscles are inserted into the edges of the interneural and the median ridge. A diagram of the musculature is shown in Fig. II. The muscle placed cranially elevates the spine, that caudally depresses it; named for convenience "*Levator spinæ*" and "*Depressor spinæ*" respectively.

Careful dissection of the soft tissues about the spine will reveal two sacs, one on either side of the spines, brownish in colour in preserved, pearly white in fresh specimens. (See Figs. II and III.) These sacs vary a little in size but well developed they measure, both together, about 0·5 cm. across, each being about 1 cm. long, extending down the lateral grooves of the spine from within about 0·5 cm. to 0·7 cm. of the tip to 1·5 cm. to 1·7 cm. down the spine. A duct, very tiny but visible through a hand lens, runs from the sacs along the lateral grooves towards the tip of the spines where it is lost to view.

The spines do not always bear uniformly well-developed sacs. In all three specimens examined the sacs in a few instances were reduced to mere vestiges. In specimen Q.M.I/2217 the sacs of the 2nd spine were vestigial; there were no

Text-figure 2.—Diagram of levator and depressor muscles of spine.

Text-figure 3.—Poison sac of *Synanceja horrida*.



Text-figure 4.—Diagram of histology of "Broad tubercle."

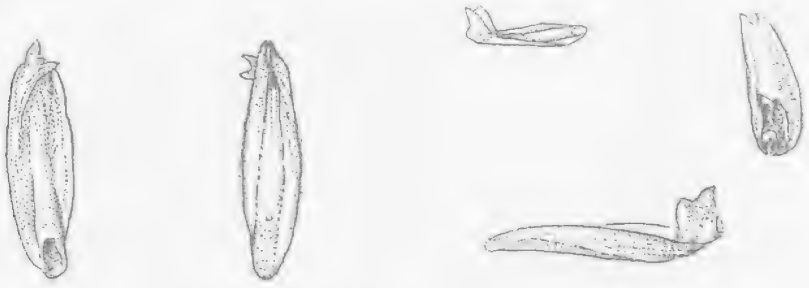
sacs on the 4th, but those of all other spines were well developed. [Specimen B.L/F.II had no sacs at all—see Appendix.] The microscopic structure of the sacs has been studied in serial sections and will be described later.

OTHER SKIN GLANDS LIKELY TO BE INCRIMINATED AS VENOM SECRETORS.

Tubercles.—*Synanceja horrida* is covered with well-developed tubercles of two kinds—(*a*) broad and relatively flat, (*b*) narrow and high (nipple-like).

(*a*) The broad tubercles occupy principally that portion of the skin situated along the cranial half of the dorsal fin and between it and the operculum. They secrete a mobile milky fluid which we have not yet had an opportunity to examine critically. An account of this fluid will be given in

another paper. [This has since been done.] But the nature of the exudate, its microscopic appearance, and the histological structure of the tubercles lead us to believe that this fluid is toxic. The tubercles consist of a sac opening on the surface by a fine pore more deeply pigmented than the surrounding skin. The histological structure of these broad tubercles is very simple and is shown in Fig. IV.

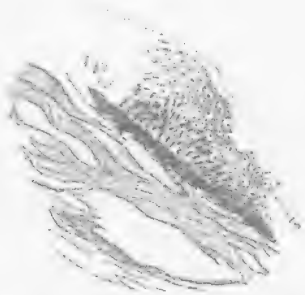


Text-figure 5.—Various aspects of "sense organ."

It consists of aggregations of small, almost perfectly circular cells containing one, sometimes two nuclei, in a matrix of dense fibrous (collagenous) tissue. The cell columns lie just outside the lining membrane of the sacs, and

Text-figure 6.—Section of skin over sense organ.

Text-figure 7.—Section of slime-gland.



Text-figure 8.—Section of skin.

in the sacs themselves may be seen small clumps of similar cells, the nuclei of which stain very deeply, while the cytoplasm stains feebly and is almost transparent. These tubercles are true glands; they are contractile and during life

project with considerable force the fluid referred to. After death of the fish pressure on the tubercles produces a similar effect.

(*b*) Narrow High Tubercles.—These are arranged in a row along the side of the fish, being definitely connected with each other along their whole length of the row and are associated with the "sense organs" of the skin, which underlie them. The form of the "sense organ" is shown in Fig. V, and the histological structure of the overlying tubercle in Fig. VI. The "sense organ" is tubular along its whole length, but it does not seem to have any directly defensive or offensive function.

Skin Glands.—Casual study of these glands reveals a histological structure shown in Fig. VII. They are particularly abundant over the whole skin, and in structure are similar to the slime glands described and figured by Reed (*loc. cit.*). At the end distal from the surface the cells are large and ovoid, containing either one very large multilobar nucleus or two or more nuclei, which in general stain deeply. Nearer the surface these cells tend to become spherical with a compact rounded nucleus. The lining cells of the duct are flattened and elongated.

As has been noted, these glands are noticeably numerous, which goes perhaps to explain the extraordinarily abundant secretion of slime over the whole fish noticed in all the live or recently dead specimens examined. In every case we found the fish completely covered by a slime so dense that the fish rather resembled a rock completely overgrown by marine flora, and so firmly adherent that heavy hosing was needed to remove it.

Incidentally after removal of this coating of slime the colour of the fish was shown to be rather beautiful—dappled grey and brown in general, with patches of deep violet about the pores of the tubercles over the dorsum, and rich saffron ventrally and especially under the opercular fins. Why the fish conceals this pretty natural appearance in exchange for its slimy coat of dirty blackish green is hard to explain. Reed postulates a nerve stimulus as the cause of this secretion.

Serial sections of the poison gland show the histological structure to be as follows:—

The wall of the gland which is continuous with the stroma consists of tough non-cellular fibrous tissue. In this stroma are numerous alveoli consisting of 3 or 4 lobules, circular in cross-section. The lobules consist of a dense mass of rounded or ovoid cells with a round small central nucleus. The cells are about 10 to 15 μ in diameter, and appear to stain very faintly except during periods of secretory activity. Even then the nucleus stains weakly with hæmatoxylin though the cytoplasm is distinctly eosinophilic. Some sections showed secretion lying in open spaces in the stroma near the spine. This consists of very small cells, about the size of a human red blood cell, which stain very deeply—both

nucleus and cytoplasm. In shape the typical cell is either fusiform or flattened and oblong with one or two central nuclei. The basement membrane of the alveoli is simple and consists of stroma modified as to density and direction of fibrils. It apparently contains no pigment.

Elsewhere in general and about the spines in particular the skin has the structure shown in Fig. VIII.

A detailed histological study of the skin glands is reserved for another paper. It is thus evident that the secretion of the skin glands is of two kinds—(*a*) milky white and miscroscopically cellular, (*b*) slimy and non-cellular.

TOXICOLOGY OF THE VENOM OF *SYNANCEJA HORRIDA*.

The results reported are purely qualitative for the reason that, as has been noted before, material for study is scanty, and the strictest economy has necessarily, therefore, had to be practised. These results, however, cannot fail to be convincing, and as more material comes to hand we propose to make our findings strictly quantitative. From Specimen B.L.F/I we obtained something under 2 c.c. of venom in a pure state. From our work we gather that it is not necessary to deal with live specimens. To do so indeed is rather a disadvantage, since handling of the fish irritates it and causes it to discharge its secretion so freely that it cannot be recovered uncontaminated. It appears to us, after considerable experience, to be so difficult to collect completely uncontaminated secretion from all the spines of a fish in the living state, and in the light of our findings in any case so unnecessary, that we now allow to die all live specimens sent to us, and are willing to receive fish of the species dead for 24 or even 48 hours, preserved in sea-water or on ice. In recently dead specimens we make a quick dissection of the spines, stripping away the skin and fascia so as to expose only the spines and poison sacs. All the spines are divided below the sacs with scissors and placed in a small, wide-mouthed test tube. The sacs are then opened carefully and the whole emulsified by mechanical shaking in distilled water. The spines and sac membranes are removed and the whole evaporated. The dried residue is then emulsified in normal saline solution. Whether there is any loss in toxicity of the venom as a result of this procedure we are not able to say, but the material thus prepared with which we worked produced qualitative experimental effects to our complete satisfaction.

Microscopically the emulsion is cellular—containing small, highly refractile, rounded cells with a small central nucleus—in appearance similar to those found in the secretion of the large broad tubercles of the skin. We do not, however, suggest that the secretions are chemically or physiologically identical.

From the original sample of venom studied, we obtained results which are only as yet roughly quantitative. But qualitatively we believe them to be sufficiently striking for record.

The original sample from one fish was so emulsified in normal saline solution as to give a dilution of 1 in 10. This diluted venom was used on laboratory animals as follows:—

GUINEA-PIG I.—0·1 c.c. of the venom emulsion was injected beneath the skin of the abdomen in the right side posteriorly. No exact record of the results was kept except to note that at first the animal was more active than usual, but later became very quiet, refused food, and completely lost the use of both hind limbs. This effect lasted right through the possible period of observation—about 6 hours. Satisfied that the gland secretion had a definite physiological effect, as a preliminary to further work we decided to store the venom on ice, since we wanted to know whether the toxic effect was a stable function or suffered change in keeping. In a busy laboratory this is a matter of some importance.

A week later the venom emulsion was brought to original volume and tested as follows:—

GUINEA-PIG II received 0·2 c.c. subcutaneously, and GUINEA-PIG I, 0·2 c.c. to serve as a control. Beyond a slight increase of activity the control animal showed no response over the period of observation. It had possibly acquired an active immunity. The effects on Guinea-pig II were noted:—

Immediate effect—Increased activity.

5 *minutes*—Slight intermittent convulsive shuddering. (*Note:* This effect is frequently observed in this laboratory in animals which have had to endure relatively prolonged handling.)

10 *minutes*—Continuous marked convulsive shuddering followed by spasmodic contraction of the diaphragm involving stoppage of respiration at every third or fourth respiratory effort. There is spasm of the hind limbs.

15 *minutes*—In forward movement animal can use only fore limbs properly—i.e., it walks with the fore limbs and by a jumping effort draws both hind limbs together towards the body. The hind limbs appear to be paresed.

The respiration rate is decreased.

The animal performs the act of chewing and swallowing continuously. Refuses food and crouches in a corner of its cage.

20 *minutes*.—The hind feet are splayed and spread over a wider base than normal and are extended posteriorly.

25 *minutes*—The intervals between respiratory spasms seem longer. The animal moved once spontaneously in 5 minutes.

40 *minutes*—There is complete paralysis of both hind limbs. On attempting to rise the animal rolls over on its side. It brushes its nose with its fore paws. Respirations are slow and shallow, abdominal respiratory movement being just perceptible. The hind legs are extended and spastic.

50 *minutes*—The fore limbs, especially the right, are paralysed, and both hind limbs markedly so.

The animal is completely unable to rise.

The respiratory excursion is deeper, but slow and still very shallow, respiration being mainly thoracic. The animal lies so that the fore limbs are extended flat along the ground, while the hind part of the animal is twisted so that the hip rests on the ground in the position assumed at the last attempt to rise and walk. The eyes are glazed and staring. The animal does not blink (? abolished corneal reflex).

70 *minutes*—Animal slightly recovered; attempts to walk.

80 *minutes*—Another paralytic spasm, involving chiefly right hind leg and then both hind legs.

2 *hours*—Slight general improvement.

4½ *hours*—Unable to use right hind limb.

6½ *hours*—Condition the same.

8½ *hours*—Paralyses of limbs passed off.

Next day.

12 *hours after last observation*—Animal shows slight but fairly continuous convulsive shuddering; is inactive and refuses food. Survived. Venom stored on ice.

One week later—Guinea-pig III. received 0·2 c.c. subcutaneously. Guinea-pig I. received 0·2 c.c. subcutaneously (control).

Guinea-pig I.	*Guinea-pig III.* This was normally a nervous animal.
15 minutes—Abnormally active 30 minutes—Active, feeding	Ditto.
	Very quiet, crouching. Slight convulsive shudder. Right hind limb drags on walking, though the animal can use the limb for scratching. Though a nervous animal, requires strong stimulus before it will move.
35 minutes—Active, normal	Marked transient paresis of both hind limbs, especially of the right. Brushes imaginary object from its nose. Corneal reflex +. Respirations slow and shallow.
45 minutes—Normal	Respirations very shallow. Corneal reflex sluggish.

60 minutes—Normal	Hind feet splayed. Spastic paralysis of both hind limbs. Corneal reflex sluggish.
70 minutes—Normal	Marked paralysis of both hind limbs.
90 minutes—Convulsive shuddering, still active but rolled over on hips once	0·2 c.c. venom injected. Marked paralysis of diaphragm. Simple reflex reaction time delayed.
$1\frac{3}{4}$ hours—Sluggish, slight intermittent convulsive shuddering, diaphragm retracted at every third inspiration.	As before. Respiratory movement almost imperceptible.
2 hours—Rather sluggish but quite active when stimulated	Animal anæsthetised. See below.
$2\frac{1}{4}$ hours—Fully recovered, feeding.	

Two hours after the start of this experiment, Guinea-pig III. was anæsthetised with open ether while its hind limbs were still in a state of what appeared to us to be one of maximum paralysis for the amount of venom used. The flexor muscles of the leg and the sciatic nerve were quickly exposed, and subjected to a very weak faradic current in an attempt to determine whether the venom acted on the end plates of the motor nerves. From our observations recorded above (necessarily incomplete) we surmised that the action of the venom was, similar to that of cobra venom [Cushny[5]], neurotoxic not myotoxic. Both muscle and nerve, however, gave a response.

The experiment is, however, by no means conclusive, for two reasons: (1) The instrument used was that commonly employed for testing degenerated muscle response in humans. Since the strongest current supplied was just sufficient and all the others insufficient to elicit a response by human muscle, the instrument was tentatively tried on our animals. Possibly even then the current was too strong to elicit differences in response in guinea-pig muscle. (2) The dose of venom was too small to produce effects which could be distinguished from normal responses of nerve or muscle by the apparatus at our disposal.

Both of these factors probably operate, and we are investigating further on these lines, since our experiments leave no room for doubt that the venom is definitely neurotoxic or myotoxic.

We should like to remark here upon the marked abnormal activity of our animals immediately after receiving venom. We interpret this to signify the presence of pain in the animal. We have been careful to exclude any other stimulus which might produce this result, and conclude by analogous observations on other animals that this increased activity is probably due to actual local pain at the site of inoculation.

Hæmotoxic Action of the Venom.

This experiment was only roughly quantitative since our supply of venom was very small. In the first instance we desired to establish only that the venom was hæmotoxic or not. The following series was set up, and the results are recorded in the table below:—

The venom was thoroughly emulsified by shaking in the original dilution of approximately one part of venom to nine parts of 0·85 per cent. saline solution—(Venom A).

This was allowed to settle and the supernatant pipetted off—(Venom B).

A and B were then mixed with a 3 per cent. suspension of guinea-pig red blood cells, thrice washed.

At the same time the protective action of serum was tentatively investigated.

The results are set out in the table below:—

Venom c.c.	Cells 3% c.c.	Serum c.c.	Saline.	Hæmolysis.
A 0.1	0.1	Nil	To 0.3 c.c.	++++
B 0.1	0.1	Nil	To 0.3 c.c.	+++
A 0.1	0.1	Heated 0.04	,,	+
A 0.1	0.1	Heated 0.1	Nil	trace
A 0.1	0.1	Unheated 0.1	,,	—
Control—				
A Nil	0.1	Nil	To 0.3 c.c.	—

Incubated at 37 deg. C. for 1½ hours, and then at R.T.° for 15 hours.

++++ = Complete hæmolysis. +++ = 75 per cent. hæmolysis. ++ = 50 per cent. hæmolysis. + = 25 per cent. hæmolysis. — = 0 per cent. hæmolysis.

It seems also as if the inhibitory substance in normal unheated serum is thermolabile. This aspect of the question, however, requires a lot more investigation. [We have since investigated this problem, and our results will later appear in another place.]

SUMMARY.

1. The myology and anatomy of the dorsal fin spines of *Synanceja horrida* are described.

2. The histology of the poison sacs of the dorsal spines and of certain skin glands is defined.

3. The sacs of the dorsal fin spines are shown to secrete a venomous substance, on the following grounds:—

(*a*) The substance within the sacs exerts a toxic action on the voluntary and involuntary muscles of laboratory animals. Whether this action is neurotoxic or myotoxic has not been definitely determined. It is probably neurotoxic.

(*b*) This substance has a lytic action on the red blood cells of guinea-pigs.

4. The lytic substance of *Synanceja* venom can penetrate red cells independently of the aid of fresh serum.

5. Fresh unheated serum probably inhibits the action wholly or partly of the venom.

6. The inhibitory substance in the serum is probably thermolabile.

7. Recovery from the gross effects of the venom conveys some degree of active immunity.

APPENDIX.

In the course of this research we have found the distribution and size of the poison sacs of *Synanceja horrida* to be variable, as noted in the paper.

Specimen B.L./F.II had no poison sacs at all. In addition, this fish showed a complete absence of the fourth dorsal spine, the skin of the third posteriorly and that of the fifth anteriorly being continuous with the skin of the dorsum generally, and having no direct connection one with the other.

In a fifth specimen just received in this laboratory from Sandgate, the sacs on the first five spines, counting from the cranium, were purely vestigial. They increased in size and venom content up to about the tenth, and from that to the thirteenth were below average size.

Clinical Notes on a Case of Poisoning by Stone Fish Venom.

Supplied by M. J. Gallagher, M.B., Ch.M., Mackay.

"On the evening of 22/2/25 Mr. E.M.B. stood on a 'stone fish' in the Pioneer River, Mackay. The spine of the 'stone fish' entered the sole of his foot midway between the ball of the great toe and that of the little toe. Instantly the pain in the foot was intense, the patient felt nauseous, and upon hopping about two paces to the bank he collapsed and fainted. He recovered sufficiently to drag himself to his house, 100 yards away, when he again fainted. His wife and some friends put him on his bed, where he fainted once more. Upon recovering he was given brandy and his foot was put into a bucket of hot water. His pain was only slightly eased, and as he still felt cold and sick his friends prevailed on him to consult a doctor. About three hours after receiving

his injury he was brought into my surgery. He looked pale and ill—cold perspiration about his brow and around his lips; temperature 96·4 deg. F., pulse 110.

"The sole of his foot was swollen in the region of the wound. It was opened up and swabbed with pure carbolic acid and methylated spirit. There was no discolouration of the tissues around the wound. The patient elected to go home, and his friends carried him out to a motor-car, where he fainted. Upon coming round he still desired to go home, where he arrived in due course. Forty-four hours later I saw him at his home and he said he was suffering agony. His foot was enormously swollen and his leg up to the knee was intensely swollen, red, shining, and tender. (Temperature 102·4 deg. F., pulse 108, respirations 26.) He was taken immediately to hospital, where hot baths alternated with ichthyol foments to his leg for forty-eight hours; then under general anæsthesia multiple incisions were made in the cellulitis of his foot and leg. The whole of the skin and subcutaneous tissues of the foot and leg, in its whole circumference as far as the knee, formed but the outer wall of a bag of pus, the inner wall being formed by the deep fascia covering the muscles and bones.

"He improved progressively every day both in his general condition and leg condition, and all went merry as a marriage bell until 10.30 a.m. on 7/3/25 (fourteen days after injury), when, without warning, he felt as though a boa-constrictor had suddenly thrown its coils around his waist and was squeezing the breath out of him. The pain was most intense—his words were 'frightfully unbearable'—and appeared to be in the epigastrium, as though all his viscera had been tied in a knot and the knot gradually tightened.

"He had increasing difficulty in breathing, until finally he felt his breathing stop completely and he lost consciousness. Just before losing consciousness he had pressed his bell, and when the nurse arrived she found him unconscious, cyanosed, saturated with perspiration, and gasping for breath.

"Artificial respiration soon restored him to consciousness, and with great difficulty he was able to whisper—'Can't breathe—terrible pain in stomach.'

"Mustard plaster to epigastrium, H.I. morphine gr. ¼, atropine gr. 1/150, tetanus antitoxin 6000 units intrathecally, 15000 units subcutaneously.

"No further spasm occurred, but stiffness and soreness around epigastric region lasted for about four days after attacks, and during a period of eighteen months from time of seizure. He had four periods during which he felt a tightness in the epigastrium and had slight difficulty in breathing. He has been free from these attacks for the last six months (up to February 1928).

"On 28/3/25 skin-grafted a large denuded area which had sloughed out over the instep.

"The patient was totally incapacitated for over four months. He is now (February 1928) quite well, and has only slight limitation of extension of his ankle, but it is insufficient to cause him any real disability."

[NOTE.—Dr. Gallagher's vivid narrative would have been a striking confirmation of our findings had he not raised the question of the respiratory failure being due to tetanus. So keen an observer as Dr. Gallagher shows himself to be would not have failed to observe spasm of other muscle groups, which I think would undoubtedly have occurred as a result of tetanus toxin. Also, I do not think tetanic symptoms would have subsided so rapidly even after such large doses of antitoxin. Diaphragmatic spasm alone is a constant symptom of poisoning by animal venoms, though it is undoubtedly difficult to explain the obviously late development of this effect in this case. In our laboratory animals it is one of the earliest effects, but it passes off relatively quickly, as our experiments show.

On the whole, however, I am inclined to attribute this striking effect to the *Synanceja* venom. Though Dr. Gallagher's observations tend to confirm our findings and those of other workers on snake venoms, and though that fact affords us some little satisfaction, we cannot but regret the terrible and unfortunate fact which preceded that confirmation.]

LITERATURE CITED.

1. Reed (1924).—Zeitschr. für Morphologie und Anthropologie, Stuttgart, bd. xxiv, 2.
2. Citterio (1925).—Atti della Soc. Ital. di Sci. Nat. in Milano, lxiv, 1.
3. Evans (1923).—Phil. Trans. Roy. Socy., B. 391.
4. Bottard (1889).—Contribution à l'Hygiène Navale. Paris: Doin.
5. Cushny (1916).—Phil. Trans. Roy. Socy., B. 348.

NOTES ON THE DINGO, THE INDIAN WILD DOG, AND A PAPUAN DOG.

By Heber A. Longman, F.L.S., C.M.Z.S. (Director).

Through the kindly suggestion of His Excellency Sir John Goodwin, a specimen of the Indian wild red dog (skin and skull), obtained from the Nilgiri Hills, was recently forwarded for the Queensland Museum collections by the Hon. Secretary of the Bombay Natural History Society. It is of interest to record that, when the skin was placed with other flat skins of the Dingo, several local naturalists who are very familiar with the Australian dog unhesitatingly assumed that it was a local specimen. In view of the resemblance of this particular skin to our material, other comparisons were made, although it was realised that the cranial and dental characters associated with the genus *Cuon* have been usually interpreted as denying close relationship with other dogs.

When briefly reviewing this question, A. A. Dunbar Brander, in his interesting account of the Indian Wild Dogs, says that "there is probably no animal, even the wolf included, which more nearly resembles the tame dog in his characters and habits, and it is no exaggeration to say, that in the event of the tame dog making to the jungle we could expect its conduct to be in most respects similar to that of the wild animal."[1]

This is not the place to review in detail the several names that have been given to the wide-ranging Indian wild dogs, usually placed in the genus *Cyon*, or more correctly, *Cuon*. Two species were recognised by Mivart in his "Notes on the Genus *Cyon*," in 1890,[2] and also by W. L. Sclater in his Catalogue in 1891.[3] The North-Asiatic species, *C. alpinus* of Pallas (1831), does not concern us. The second species, variously recorded as *primævus, sumatrensis, dukhunensis, rutilans,* and *javanicus,* if considered in the wide sense, should be known as *Cuon javanicus* Desmarest (1820),[4] as that name has precedence.*

Although Hodgson originally described his *primævus* in 1833[5] as *Canis*, he subsequently established the genus *Cuon* for these Indian dogs because of the deficiency in the mandible of the third molar.[6] Lydekker,[7] however, still included these dogs in *Canis* in 1900.

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[1] 1923. A. A. Dunbar Brander, "Wild Animals in Central India."
[2] 1890. St. George Mivart, P.Z.S., p. 88.
[3] 1891. W. L. Sclater, Catal. Mamm. Ind. Mus., pt. 2, p. 260.
[4] 1820. Desmarest, Mammalogie, p. 193.
[5] 1833. Hodgson, P.Z.S., p. 111.
[6] 1838. Hodgson, Ann. Mag. Nat. Hist., vol. 1, p. 152.
[7] 1900. Lydekker, "Great and Small Game of India," &c., p. 344.

* The Honorary Secretary of the Bombay Natural History Society refers to the specimen sent as *Cuon dukhunensis*, and kindly gives the following references to articles in their Journal:—"Notes on Wild Dogs," vii, No. 4; "The Indian Wild Dog," x, No. 3; "A Wild Dog's Earth," xiii, No. 3; "Wild Dog Hunting," xvi, No. 4; "Wild Dog in Burma," xxviii, No. 1; "In the Haunts of the Indian Wild Dog," xxix, No. 2.

E. D. Cope considered that Hodgson's genus *Cuon* was identical with *Speothus*,[8] a genus established by Lund in 1839 for an extinct species found in caves in Brazil, which Huxley placed as congeneric with *Icticyon*. Huxley considered *Cuon* as a sub-genus of *Canis*.[9]

In his paper on "Some South American Canidæ," Einar Lönnberg points out that m_3 is missing on both sides in an example of *Pseudalopex lycoides* and refers to the variability of this unit, "which is always small and more or less useless as it sits so far back that it has no antagonist to work against."[10] This tooth is also missing on both sides in a mandible of a grey wolf in our collection, but it, or the alveolus, is invariably present in our series of fourteen mandibles of Dingoes. There is no evidence of wear in this tooth, however, in our specimens of Dingoes or domestic dogs, and Lönnberg's remarks appear to be significant. There are records of its rare occurrence in specimens of *Cuon* itself (Huxley, *loc. cit.*, p. 274), and possibly studies of juvenile mandibles would demonstrate that the germ of this minor member of the molar series is not completely lost in *Cuon*. Thus it seems somewhat arbitrary to eliminate remote progenitors of the Indian wild dog from the lineal ancestry of the Dingo on the sole basis of this variable distinction. The several fossil species of *Cuon* described, however, show that this deficiency in the molar series is not confined to modern species. The variability of the dental series in the Canidæ is also illustrated by the studies by Windle and Humphreys of accessory molars,[11] and Mivart (*loc. cit.*) records a skull of *Cuon* in which there was no trace of the second upper molar.

Most of the literature regarding the Dingo and its antiquity in Australia has been traversed by the late R. Etheridge, jr.,[12] and by Professor F. Wood Jones.[13 14]

In his papers the latter writer gives an excellent account of the Dingo, and reviews the theories advanced by previous writers. He considers it to be not of specific rank, but a sub-species of *Canis familiaris*. As long ago as 1880, Huxley (*loc. cit.*) pointed out that "there is nothing peculiar about the Australian Dog."

Following the researches of G. S. Miller, G. M. Allen, and others, it seems fairly certain that all domestic dogs have descended from a wolf-like ancestor. Wood Jones points out that the Dingo may be separated from other breeds of domestic dogs by its relatively larger teeth, being more wolf-like in this respect.

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[8] 1879. E. D. Cope, Proc. Acad. Nat. Sci. Phil., p. 185.

[9] 1880. T. H. Huxley, P.Z.S., p. 278.

[10] 1919. Einar Lönnberg, Arkiv for Zoologi, bd. 12, No. 13.

[11] 1890. Windle & Humphreys, P.Z.S., p. 29.

[12] 1916. R. Etheridge, jr., Mem. Geol. Surv. N.S.W., Eth. Ser., No. 2.

[13] 1921. F. Wood Jones, Tr. Roy. Soc. South Aus., xlv, pp. 254-263.

[14] 1925. F. Wood Jones, The Mammals of South Aus., pt. iii.

Utilising his data and supplementing his figures with our own measurements, it may be stated that in the Dingo the antero-posterior length of the carnassial is more than 10 per cent. of the basal length of the skull. In domestic breeds the length of the specialised tooth is usually distinctly less than 10 per cent. of the basal length of the skull, and this ratio is very rarely exceeded. Owing to the contracted contours of the bull-dog's head, however, exceptions will be found in Windle and Humphreys' table of measurements for this and some other breeds.[15]

In our specimen of the Indian dog the basi-condylar length of the skull is 181, and the length of the carnassial is 21·5. The carnassial is thus relatively longer in the Indian Dog than in the Dingo, and it is distinctly greater than the combined lengths of the following two molars. In the Dingo the length of the carnassial is about equal to that of the two molars. The first upper molar of the Dingo is relatively broader than that of the Indian Dog. In the absence of a well-marked cingulum on the upper molars *Cuon* agrees with the true dogs and wolves and is unlike the Jackal and Fox. As noted by Mivart (1890, p. 88), the cranium in *Cuon* is but little elevated in the interorbital region, when seen in profile, being very distinct from the Dingo, which, owing to the development of large frontal sinuses, has a pronounced downward curve to the nasals. There is little evidence in the Indian Dog of the outward bend of the lower dental series at the junction of the premolars and molars, which is characteristic of the Dingo and most dogs and wolves, but which is not found in the Coyote and Jackal.

As was pointed out by Forsyth Major (P.Z.S., 1900, p. 833), the talon of the lower carnassial in *Cuon* is unicuspid, whereas in *Canis* "it is composed in the main of a strong outer and a lesser inner tubercle." This distinction has been useful in the study of fossil species.

The skull of a Dingo used by Mivart (*loc. cit.*) for comparison with *C. javanicus* was longer than that of the Indian species, but his comparative measurements show that *Cuon* is relatively broader.

It will be thus seen that the cranial distinctions between *Cuon javanicus* and the Dingo are considerable, apart from the characteristic deficiency in the lower molar series.

In both the Dingo and Indian Dog the characteristic colouring of the body is a uniform reddish brown, and the presence of an occasional white tip to the tail is common to each. Both dogs have erect ears and a bushy tail, and neither can bark. Adult specimens of each are practically untameable, although the Dingo is now more feral than in the early days of the aborigines, whose "gins" occasionally suckled the pups.

[15] 1890. Windle and Humphreys, P.Z.S., p. 18.

Sir John Goodwin informs me that the Indian wild dogs are characteristically silent when hunting, but when surprised by man in the jungle they will yap repeatedly as they retire. When in retreat they disdain to take cover.

As is well known, the Dingoes are silent hunters. Their dismal howl, which is a common note in the wilder parts of the Australian bush, is characteristically nocturnal, and is evidently a social habit. Occasionally they are heard yelping in secluded places in the daytime. Usually the Dingo does not yelp when surprised by man, but Mr. H. G. Barnard tells me that when a bitch has pups she will move some distance away and yelp at a disturber. There are usually five pups in the litter. An excellent photograph of a Dingo pup by C. Barrett appears in the Australian Museum Magazine, vol. iii, No. 6, 1928.

The Dingo is notorious as a destroyer of sheep, and frequently kills calves and poultry. Probably he is of some value at times in keeping down rabbits, but he is the "Ishmael" of the bush and every man's hand is against him.*

Wood Jones records that the general colour may vary from black to almost white. Black and tan examples are occasionally noted, and it is evident that these variations in colour have existed from early days.

In this connection I must find space for an interesting note regarding a black Dingo pup, from the diary of Major Lockyer on his visit to Stradbroke Island in 1828, which is reprinted by George Watkins in his "Notes on the Aboriginals of Stradbroke and Moreton Islands":—"The attachment of these people to their dogs is worthy of notice. I was very anxious to get one of the wild native breed of black colour, a very handsome puppy, which one of the men had in his arms. I offered him a small axe for it; his companions urged him to take it, and he was about to do so, when he looked at the dog and the animal licked his face, which settled the business. He shook his head and determined to keep him."[16]

Possibly new data on the ancestry of the Dingo may be gained from studies of serological isoagglutination, the method having been used for phylogenetic studies of sheep by Kaczkowski, noted in a paper read before the Royal Society of Edinburgh.[17]

Papuan Dogs.—There are two skins and two skeletons of Papuan dogs in the Queensland Museum. The first (No. 3751) was described by C. W. De Vis in 1910.[18] A skin (No. 3223) was received from His Excellency Sir Hubert Murray in 1918, and subsequently a skeleton (No. 4083), belonging to another dog, was received from the same source. These specimens all came

[16] 1891. George Watkins, Proc. Roy. Soc. Qld., viii, pt. 2, p. 42.

[17] 1927. B. Kaczkowski, reported in "Nature," 3rd December, p. 825.

[18] 1910. C. W. De Vis, Ann. Qld. Mus. No. 10, p. 19.

* Payments of 15s. bonus per scalp are now made through Dingo Boards in Queensland, and it is estimated that the yearly average of payments is over 50,000. In 1926, 52,249 scalps were paid for, but this includes a few foxes.

from the Mount Scratchley district in the northern division of Papua, or British New Guinea. As they were originally obtained from the natives, some doubt was expressed by Papuan officials as to whether they were really feral. The general colour of the first skin was "black and white, the black dominant; the white portions are a long irregular patch on the nape, another covering the chin, throat, and breast, and contracting to a point on the abdomen; the paws, left tarsus, and tip of tail are white also; the inguinal region tawny white."

The general colour of the second skin corresponds with Ridgway's "russet," interspersed with darker hairs, especially on the tail, the limbs being lighter.

The basi-condylar length of the cranium of 3751 is 146 mm., and the antero-posterior length of the upper carnassial is 16. For No. 4083 the corresponding dimensions are 149 and 15·5. The upper carnassial is about equal to the combined lengths of the two molars, and this proportion is usually found in the Dingo and some other dogs. The breadth of the palate between the canines is relatively greater in the Papuan specimens than in the Dingo.

These Papuan specimens are a small breed of true dogs, possibly not truly feral or autochthonous, with no obvious distinctive features, and apparently not very closely related to the Dingo. But it is of interest to note that this race agrees with the Dingo, the Indian wild dog, and the wolf in the relatively large proportion of the upper carnassial, which is more than 10 per cent. of the basi-condylar length of the skull. This proportion appears to be a useful distinction in the ratios found in adult crania of dogs.

In very old and exceptionally large Dingoes, owing to the growth of the skull, the length of the carnassial may be somewhat less than 10 per cent., but with ordinary adult skulls there is probably an indication of a domestic strain if the carnassial length does not attain this ratio. Unfortunately, I have no measurements of the well-known "heelers," the valuable cattle-dogs, which were originally the result of a cross between the Dingo and the merle. Some authorities consider that there is a strain of the Dingo in the kelpie, the well-known Australian sheep-dog, and this matter has been concisely reviewed by R. L. Kaleski.[19]

Measurements.

	Basi-condylar Length.	Upper Carnassial Length.
Indian Dog, J. 4709	181 ..	21·5
Papuan Dog, J. 3751	146 ..	16
Papuan Dog, J. 4083	149 ..	15·5
Gray Wolf (Qld. Mus.)	236 ..	25
C. lupus lupus (Miller)	255 ..	27
Dingo (average of ten, Qld. Mus.) ..	181 ..	20
Domestic Dog (Miller)[20]	230 ..	21·6
Great Dane (Winge)	255 ..	22
St. Bernard (Wood Jones)	248 ..	20
Irish Setter (Qld. Mus.)	203 ..	20
Prize Collie (Qld. Mus.)	210 ..	20

[19] 1926. Encyclopædia of Australia, Angus and Robertson, ii, p. 452.
[20] 1912. G. S. Miller, Cat. Mam. West. Eur. Brit. Mus., p. 313.

It will be noted that the Indian and Papuan dogs agree with the Dingo and the wolf in the relatively lengthy carnassial. In the measurements of nine crania of "*Cyon*," recorded by Huxley (*loc. cit.*, 1890, p. 275) the carnassials are well over 10 per cent. of the total length.

In his article on "The Native Dog of Western Polynesia," B. G. Mahony states that among the small true native dogs the two predominating colours are "reddish-tawny or glossy-black."[21]

In his useful study of "Dogs of the American Aborigines," which contains a valuable bibliography, Glover M. Allen[22] considers that "the wild progenitor of the dog was a small wolf of a species distinct from the large wolves of circumboreal distribution. It is natural to look to Asia for this unknown ancestry. . . ." In a paper which the writer has not been able to study, Jentink suggests the wild dog of Java as a representative of the original stock whence the domestic dog sprang.[23]

Wood Jones notes that the wild dogs of South-eastern Asia would be the most probable migrant in a "walk overland" colonisation of Australia, but eliminates them from the ancestry of domestic and feral true dogs because of the distinct dentition. The same author makes out a very strong case for his view that the Dingo did not come by a land bridge, but was brought by early aboriginal man in his pioneer voyagings.

R. Etheridge has summarised (*loc. cit.*) the evidence for fossil remains of the Dingo and its occurrence in caves and alluvial deposits. It is interesting to note, however, that among the thousands of dental fragments of marsupials in this Museum from alluvial deposits on the Darling Downs no fossil teeth of the dog have yet been traced.

As long ago as 1837 W. Ogilby stated his belief that the importation of the dingo was "in all probability contemporary with the primitive settlement of the natives."[24]

Although Charles Darwin made no special study of the Dingo, it is of interest to recall his words:—"In Australia the Dingo is both domesticated and wild; though this animal may have been introduced aboriginally by man, yet it must be considered as almost an endemic form, for its remains have been found in a similar state of preservation and associated with extinct mammals, so that its introduction must have been ancient."[25]

In his work on "Australasia," vol. i, p. 65, A. R. Wallace refers to the Dingo "as probably not truly indigenous." He adds: "It is, in fact, difficult

[21] 1915. B. G. Mahony, Journ. Poly. Soc., xxiv, p. 69.

[22] 1920. G. M. Allen, Bull. Mus. Comp. Zool. Harv., lxiii, No. 9.

[23] 1897. F. A. Jentink, Notes Leyden Mus. 18.

[24] 1837. W. Ogilby, Trans. Linnean Soc., vol. 18, p. 121.

[25] 1890. C. Darwin, Animals and Plants under Domestication, vol. i, p. 26.

to understand how such an animal could, without assistance, have arrived in the country except by means which would have equally admitted the entrance of many other animals. It differs little from the wild or half-wild dogs of India and other countries, and this is an indication that it is, geologically speaking, a recent immigrant; and there is no improbability in the supposition that the entrance of man into the country dates as far back as the cave deposits in which its bones have been found."

The voluminous literature of New Zealand dogs is summarised by G. M. Thompson, who says, "Most of the histories of the migrations of the Maori refer to the fact of their bringing dogs with them. . . ."[26]

From the evidence of such relics as the Talgai and Cohuna skulls, it is obvious that man has a lengthy history in Australia. It is very improbable that the ancestors of the Dingo succeeded in reaching Australia before man.

The story of primitive man's first advance through the islands of the Pacific, if fully known, would be one of the most fascinating chapters in the history of humanity. Doubtless the earlier pioneers found adventure in crossing a narrow strait in frail canoes or clumsy rafts, and gradually these "men of the dawn" found their way farther south and east. This pioneering was almost certainly associated with the dog, at first only tameable as a puppy, the old *Canis ferus* gradually evolving into *Canis familiaris,* though lapsing occasionally into primitive wild ways. Ultimately man and his dogs reached Papua, Australia, and New Zealand.

In a previous paper[27] the writer has touched the origin of our marsupials, which also, in a far earlier period, traversed the northern land masses which later became an archipelago. But, compared with these, man and his dogs are but recent migrants.

Man and the Dingo in Australia have undergone a somewhat parallel course of evolution. Primitive man was isolated in Australia for a sufficiently long time to develop into a distinct race—a race almost as distinctive as that of the Negro, the Mongol, or the Caucasian. The Neanderthaloid characters frequently seen in the crania of Australian aborigines suggest that the first migrants were an offshoot of the widely spread Neanderthal species. The Dingo, co-voyager with man, has also been sufficiently long in the land to develop into a distinctive race, but the relatively large size of its teeth and its feral habits present evidence of its descent from wolf-like ancestors in Asia.

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[26] 1922. G. M. Thomson, "The Naturalisation of Animals and Plants in New Zealand," p. 64.

[27] 1924. H. A. Longman, The Zoogeography of Marsupials, Mem. Qld. Mus., viii, pp. 1-15.

A LARGE JAW OF *PALLIMNARCHUS POLLENS*.

By Heber A. Longman, F.L.S., C.M.Z.S. (Director).

Plate XVIII.

In January last the writer received a massive fragment of a crocodilian jaw from Macalister, Darling Downs, which was found by Mr. W. A. Ross, and forwarded through Mr. Thomas Jack, of Dalby. This was received with a small fragment of a maxilla (palatal portion), belonging either to *Euryzygoma*[1] or to *Nototherium*, and both specimens were discovered in the bed of the Condamine River, "evidently having been washed out of a bed of blue clay."

The fragment consists of the anterior moiety of the right mandible, and is 380 mm. in maximum length. The dentary is incomplete, but thirteen teeth are represented either by alveoli or incomplete remains.

The massive proportions, especially in the symphyseal region, the large size of the first tooth and the enormous size of the fourth tooth, and the irregular lateral contours of the dentary are outstanding features of the fossil.

Although its measurements are in excess of all specimens of *Pallimnarchus pollens*[2] previously received, this jaw from Macalister has been placed with that species because it agrees generally with the proportions of the type material, and also with the skull from Lansdowne Station, described by the writer in 1925.[3]

With the exception of the fifth tooth, which has been protected by the raised border of the fourth, the crowns of all the teeth are missing. The first tooth, which is broken off at the alveolar border, is 30 mm. in diameter. (The presence of an unusually large first lower tooth had been postulated by the size of the recesses in fragments of premaxillæ previously collected.) The alveolus of the fourth tooth is no less than 37 mm. in diameter, and the border is raised considerably above the level of the other teeth. The tenth and eleventh teeth are also enlarged, the diameters being approximately 25 mm.

This mandible is prominently festooned, heavily and ruggedly sculptured, and deeply pitted, much more so than in aged examples of *Crocodilus porosus*. Judging from the recessed surface, the splenial reached a point opposite the seventh tooth.

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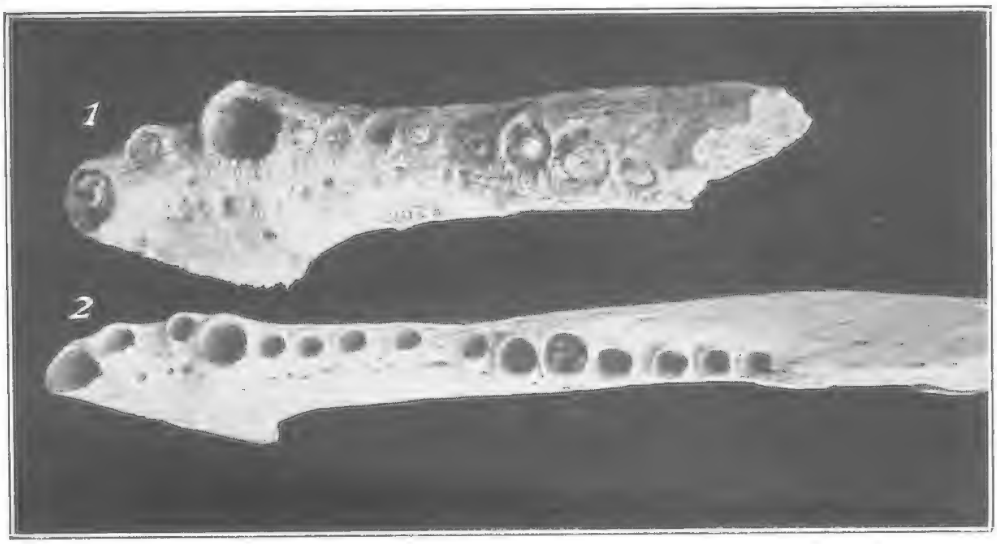
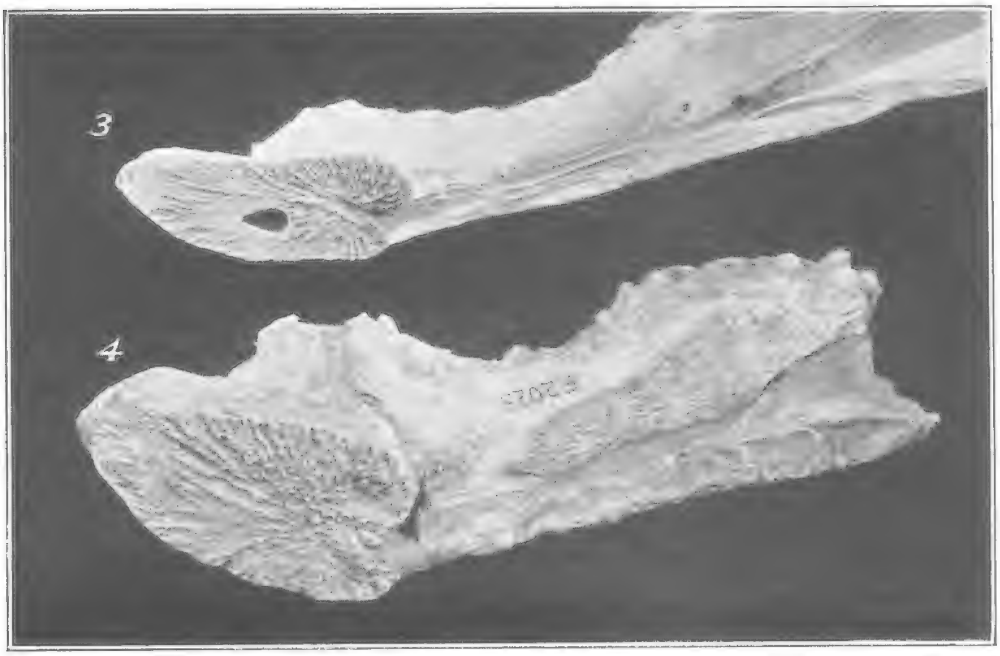
1 1921. Longman, Mem. Qld. Mus., vol. vii, pt. 2.
2 1885. De Vis, Proc. Roy. Soc. Qld., vol. ii, pt. 2.
3 1925. Longman, Mem. Qld. Mus., vol. viii, pt. 2, pp. 103-108.





Figures 1 and 4.—*Pallimnarchus pollens*, mandibular fragment from Macalister, 380 mm. in length.

Figures 2 and 3.—*Crocodilus porosus*, shown for comparison.

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The length of the symphysis is 130 mm., and its thickness attains no less than 68 mm. The symphysis ends at a point parallel with the centre of the sixth tooth, whereas De Vis in his description of the "young lower jaw" of his type material notes that "it attains the level of the posterior third of the fifth alveolus."

In juvenile specimens of *Crocodilus porosus* I find that the symphysis ends parallel with the anterior borders of the fifth tooth; in the adult, however, it ends parallel with the posterior border of the same tooth. The symphysis thus becomes more extensive with age in comparison with the tooth-row, but the change is not a very marked one.

In *Crocodilus johnsoni*[4] the symphysis extends to a parallel between the sixth and seventh teeth, and in *Crocodilus nathani*[5] it is barely parallel with the posterior border of the fourth tooth.

The specimen probably represents an aged male, and its total length may have exceeded 20 feet. In his study of the American Alligator, A. M. Reese quotes references to the effect that the males acquire a greater size and are heavier in the head than the females.[6]

Judging from an incomplete frontal found with De Vis's original material, which also came from the Condamine, the lateral portions of the posterior border are oblique as in *Crocodilus,* and the fronto-parietal suture does not enter the supra-temporal fenestra. C. C. Mook, in his useful studies of Crocodiles,[7] notes that in Schmidt's genus *Osteoblepharon* the frontal reaches the fenestra.

Although this massive mandibular fragment does not possess diagnostic characters of generic value, it emphasises the distinctiveness of De Vis's species.

When describing the cranium from Lansdowne Station I made comparisons between *Pallimnarchus pollens* and a number of other fossil species, and these need not be repeated here. It is quite evident, however, that the chief affinities of *Pallimnarchus* are with Crocodiles rather than with the Alligators.

4 1925. Longman, Mem. Qld. Mus., vol. viii, pp. 95-102.
5 1924. Longman, Mem. Qld. Mus., vol. viii, p. 23.
6 1915. A. M. Reese, "The Alligator and Its Allies," Putnams, p. 16.
7 1921. C. C. Mook, Bull. Amer. Mus. Nat. Hist., xliv, art. xiii.

DISCOVERY OF JUVENILE LUNG-FISHES, WITH NOTES ON *EPICERATODUS*.

By Heber A. Longman, F.L.S., C.M.Z.S. (Director).

Plate XIX.

Introduction.—It is gratifying to be able to report the discovery of juvenile Ceratodus in the Enoggera Reservoir, near Brisbane. With the exception of specimens which had been bred from ova in artificial conditions, in which the maximum period of survival was two years (Bancroft, 1918, p. 92),* no juvenile Queensland Lung-fishes had previously been seen.

During the process of clearing the reservoir of the prolific "water hyacinth" (*Eichhornia speciosa*), matted masses of this weed were pulled on to the bank near "the bywash" on 29th February, 1928, and on 2nd March, and seven young Ceratodus were found hiding in this material. These were transferred to cans and brought to the Queensland Museum, where they were placed in one of our large aquaria. The actual maximum lengths in millimetres of the specimens were as follows:—

Reg. No. I. 4436, 150; I. 4437, 146; I. 4438, 110; I. 4441, 148; I. 4442, 150; I. 4443, 145; I. 4444, 96.

It will be seen that, at the time of transference to the aquarium, the juvenile Ceratodus ranged from 96 to 150 mm. in maximum length.

It is my pleasant duty to express keen appreciation of the work done by officers of the Metropolitan Water Board in carefully preserving this material. The President, Mr. E. J. T. Manchester, and also Mr. C. G. Ede, have taken a special interest in this matter.

In view of the great interest attached to these remarkable fishes, it has been considered advisable to give a short account of these specimens and also of the adults in our aquaria, together with a concise historical résumé of the work done on Ceratodus, with some references to the voluminous literature of the subject.

Transportation.—In his "Report on Preservation of Ceratodus," given to the Royal Society of Queensland in September, 1896, D. O'Connor gave interesting information regarding the transference of sixty-nine live specimens

* References are given at the end of paper.

to new habitats in 1895 and 1896. In the first place 109 specimens were caught in the Mary River, near Miva, and its tributary Munna Creek. Of the sixty-nine suitable for transport, eight were put in the North Pine River, five in a lagoon near the Albert River, eight in a dam at Cressbrook communicating with the Brisbane River, eighteen in the Enoggera Reservoir, twenty-one in the Condamine at Warwick, sixteen in the Upper Coomera, two in the Botanic Gardens pond, and one was used for public exhibition. All of the specimens were large fish, ranging from "thirty-three to forty-five inches in length and were from nine to fourteen lb. in weight." These Ceratodus were successfully transported in boxes containing river weed which was kept moist. O'Connor notes (1910, p. 384) that the fish were so flexible that one of them was able to reverse its position in its narrow compartment.

Transportation Overseas.—In 1898 O'Connor successfully transported four large Ceratodus from the Mary River to London and Paris. Two of these were placed in the Zoological Gardens, London, in June of that year, and one of these died in 1915. The other lived until 31st December, 1927, nearly twenty years later ("Field," London, 21st January, 1918). These two fishes were the subject of Bashford Dean's interesting articles (1906 and 1912), which added much to our knowledge of Ceratodus.

Absence of Juvenile Specimens.—In 1893 Thomas Illidge, in a paper on Ceratodus, stated that he had been on the Burnett for six years and had never seen nor heard of a Lung-fish less than 4 lb. in weight. Mr. Thomas Welsby (1905, p. 180) quotes from information given by Mr. Illidge to "The Courier" that the smallest specimen caught was fifteen inches long. In 1911 T. L. Bancroft pointed out that "no one seemed ever to have caught a small Ceratodus," and that even the Aborigines "were unable to find the little fellows" (p. 251). Bancroft considered that the Lung-fishes were nearing extinction, and that in an ordinary season no newly hatched fishes succeed in escaping from their numerous enemies. Later (1924) he suggested that a biological laboratory should be established in the Blue Lake on Stradbroke Island where young Ceratodus could be reared in a protected hatchery. He also suggested that by mating Burnett River with Mary River specimens a more robust progeny might be secured (1924, p. 19).

The smallest specimen handled by D. O'Connor was twenty-six inches, but he notes (1910, p. 384) that a Ceratodus about fourteen inches in length was taken from mud in a dry season on the Burnett River, according to Mr. H. H. Wilson, of Coranga Station.

The smallest specimen in the Queensland Museum is I. 2528, 321 mm. in maximum length, obtained from the Burnett River in November, 1915, presented by Mr. H. Wilson. Another specimen, 367 mm., found during a heavy flood in Quay street, Bundaberg, in 1912, was presented by the late Dr. T. H. May. This was recorded by J. Douglas Ogilby in 1912. A specimen 400 mm.

in length was exhibited by Dr. T. Harvey Johnston before the Royal Society of Queensland (1915, p. 58). This was sent from Eidsvold by Dr. T. L. Bancroft.

In September, 1918, the writer exhibited before our Royal Society a specimen 495 mm. long, which was caught in the Coomera by Messrs. Whalley Bros., and presented to the Queensland Museum through Mr. A. A. Gilmour, manager of the State Fisheries. This relatively small specimen must have been bred in the Coomera from the large ones introduced by O'Connor in August, 1895.

According to D. O'Connor (quoted by T. Welsby, p. 184) there was evidence that a new generation of Ceratodus had been bred in the Condamine, but no specimen was forthcoming.

In December, 1913, we received a large specimen (I. 1629) from the Caboolture River.

Notes on Juvenile Specimens.—As was to be expected from the descriptions and illustrations of tiny Ceratodus bred from ova, these juvenile Lung-fishes closely resemble adults in contours and proportions. The vertical height of the posterior part of the body is considerably greater than that of the head or middle portion. These young specimens are variegated above in comparison with the uniform colour of adults. The ground colour is "ochraceous buff" (Ridgway), but this is mostly submerged in the clove-brown mottling closely distributed over the body. On the tip of the snout and on the tail the ochraceous buff colour is more prominent owing to the sparseness of the mottling. These darker spots are irregular in size and distribution. The paired fins are also mottled, but this is only noticeable in very clear water.

No accurate measurements could be made on the living specimens, but it is obvious that the posterior limbs are relatively smaller than in adults. As was shown by Semon, the anterior pair are well developed before the others appear. On the upper surface of the head there are numerous tiny perforations. These were noted by Gunther (1871, p. 514), and also may be seen in Semon's beautiful illustrations (1893, Plate VIII). The eyes are small and inconspicuous. In colour they are blue-grey, with a thin yellowish ring around the dark centre. The lower surface of the body is purplish grey.

These juvenile Lung-fishes lie on the bottom in the darker parts of the aquarium. They may be barely distinguishable, as they are often partly buried in sand and covered with débris. They prefer to lie in small hollows or half-hidden among the roots and stems of *Vallisneria*. It requires a keen eye to detect them in these conditions, and they are barely recognisable as fishes.

Aquatic Breathing.—When quiescent they breathe through their gills about fifteen times a minute, but when disturbed this may be increased to at least sixty-eight times. Apparently they breathe more through the mouth than with the nostrils, for the lower jaw is perceptibly opened with each inhalation.

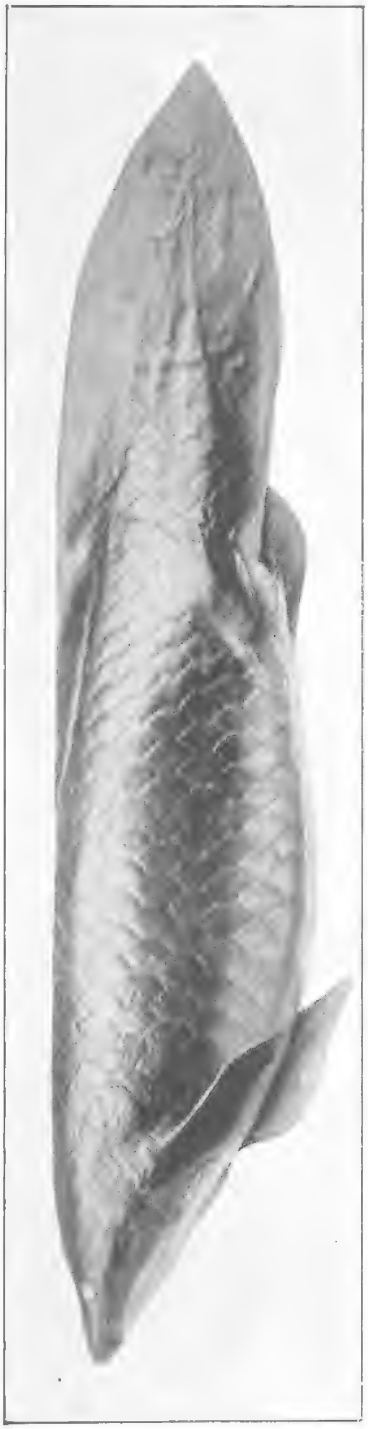

Fig 1.—*Epicrotodus forsteri* (Krefft). From east in Queensland Museum.

Fig. 2.—*Epicrotodus forsteri*. Juvenile specimen. Actual size.

Face page 162.

Use of Lung.—The lung is very rarely used in normal conditions in the clear water of the aquarium in daytime. When disturbed, however, they have been seen to rise to the surface and take in air, the subsequent escape of which has been shown by bubbles, but this is most exceptional. Bancroft (1913, p. 2) noted that his tiny specimens, bred from ova, "never come to the top to breathe air."

Food.—When a live worm is placed in the aquarium the young Ceratodus will sometimes become aware of it in a few minutes and will move from their hiding-places near by. They will gradually approach the worm, moving forward slowly by short jerks, mainly as the result of quick propelling strokes with the pectorals. Should another Lung-fish appear after the worm is actually seized, the first one will sometimes scurry away with it. Apparently they cannot easily bite their food, and they will endeavour to swallow a whole worm, which may be several times disgorged before finally devoured. In this stage the tiny dental plates have little cutting power, and even in the preserved specimen 367 mm. in length the "teeth" are barely raised above the surrounding tissues. Doubtless these plates have considerable crushing powers. Illidge reports that adult Ceratodus use the vomerine teeth for gnawing the bark of trees growing in the water (1894, p. 41). In addition to worms the young Ceratodus feed on shredded pieces of raw beef, a small quantity of which is given to them once a week.

On dull days towards evening and at night they are far more active. At night they may be seen right at the top of the tank, and they appeared to be feeding on algal growths on the water-weeds. Occasionally a young Ceratodus will tilt itself almost upon its head in order to swallow some bit of vegetable débris.

These small Lung-fish are quite defenceless when chased by other fishes, apart from their speed. At first it was necessary to place them temporarily in an aquarium with four "climbing perch" (*Anabas*), but after two days it was found that the perch were chasing the Ceratodus and nibbling at their fins. Immediately the tank was emptied and the perch were put elsewhere. Considerable difficulty was found in locating all the Ceratodus.

These juvenile specimens combine extreme sluggishness and torpidity with a capacity for quick movement when necessary. When disturbed they will dart from end to end of the aquarium with remarkable rapidity, the large caudal fin being used with great effect.

Their eyesight appears to be very poor, and they will sometimes swim swiftly against the wall or a stone. They made no movement when a bright light was flashed on the glass within an inch of them. Unlike most fishes they appear to be insusceptible to vibrations.

Aquarium.—The juvenile Ceratodus are living in a capacious aquarium which is over 8 feet in length and about 2 feet wide. This contains about 20 inches of water above several inches of sand. Numerous plants of *Vallisneria* and *Hydrilla* are present. Four adults are in an adjoining aquarium of similar proportions.

Development from Ova.—The ova of Ceratodus were discovered by W. H. Caldwell in September, 1884. After much difficulty, "as the enemies of the Ceratodus were very numerous," he succeeded in rearing Lung-fishes from ova, and one was taken alive to Sydney and exhibited at the December meeting of the Royal Society of New South Wales (Caldwell, 1885, p. 120). He noted the enormous amount of gelatinous matter surrounding the egg and the resemblance between the development of the Ceratodus and that of amphibians.

In 1893 Thomas Illidge noted the immobility of the newly hatched fish and their helplessness (p. 43). He gives quite a detailed account of the early changes in the ova after deposition. He reared and preserved specimens showing various stages of growth from one to sixty-seven days, and a series of these was preserved and placed in the Maryborough School of Arts. Later he reared twelve specimens to six or eight months, but having to take these from Gayndah to Gladstone they perished through want of suitable water. Mr. Thomas Welsby (1905, p. 180) reprints some of Illidge's information as given to the "Brisbane Courier" in July, 1902. Mr. Welsby subsequently visited Maryborough, and a concise description of the young Lung-fish preserved there appears in his book (p. 187-190).

Richard Semon arrived in Queensland from Jena in 1891, and as a result of collecting through two seasons on the Burnett he secured a valuable range of material. After many difficulties Semon ultimately obtained a fine series of young Ceratodus representing all stages up to ten weeks. Some of this material was secured by letting the ova develop in "breeding-chests," protected by fine net of wire gauze, which were anchored in the river. His fine monograph on the development of Ceratodus, with its profuse and beautiful illustrations, was published in Jena in 1893. In his popular work (1899) Semon points out that the eggs of Ceratodus are extremely frail and tender, and that there was no possibility of a natural transportation by water-birds or aquatic animals to another river. Without special attention the eggs placed in vessels died off rapidly. Semon recorded (p. 201) that some of his tiny fish, bred from ova, died as the result of "an ample dinner of meat" given by a misguided enthusiast.

Thomas L. Bancroft in 1913 (pp. 1-3) recorded a method of hatching Ceratodus ova by isolating individual eggs in bottles. Later (1918, pp. 91-94) he succeeded in rearing specimens for longer periods, one of which survived to two years of age, and "it had hardly reached the length of 5 inches." In 1915 some of Dr. Bancroft's material was exhibited before the Royal Society of Queensland by Dr. T. Harvey Johnston.

It is clearly demonstrated that there is no larval metamorphosis in our Lung-fishes. No cutaneous gills or cement organs are present in the early stages, as in the African *Protopterus* or the South American *Lepidosiren*, in which the lung is double (Dipneumones).

Adult Specimens.—Four living Ceratodus are at present in an aquarium here. One of these was received from Dr. Bancroft, Eidsvold, Burnett River, in May 1924, and was then approximately 2 feet in length. Three others were received from Dr. Bancroft in May 1926, and these ranged from 2 feet 7½ inches and 2 feet 8½ inches, to 3 feet 4½ inches. These specimens have never deposited ova, and they have never exhibited the "deep orange-red" colour on the ventral surface noted by Schmeltz (1876, p. 138), which may be associated with the breeding season. The general colour of the body, apart from the ventral surface, is clove-brown with a greenish tinge, and this colour extends to the paired fins and the whole of the tail. The ventral surface of the body varies from whitish to pale yellow. At one time Dr. Bancroft considered that the males were yellow and the females pinkish, but he now doubts whether there are distinctive colours for the sexes. Our specimens all have a narrow white margin to the paired fins, and this feature was also noted by Bashford Dean. There is also a narrow whitish margin on the scales surrounding the eye.

The largest preserved specimen in the Queensland Museum is 41 inches. It is frequently stated that these Lung-fish grow to at least 6 feet, and there is a newspaper report of one obtained many years ago by Mr. H. Geisler, of Gayndah, which was 6 feet 7 inches, and weighed 82 lb. Baldwin Spencer (1892, p. 24) quotes 87 lb. as a record.

It is very evident that these adult specimens grow very slowly, and it has been suggested that a specimen which attained 6 feet would be about 100 years old.

Breathing.—There are serious discrepancies in the accounts of lung-breathing, so much so that it seems probable that some fish may use their lung much more frequently than others. Bashford Dean (1912, p. 611) notes a maximum of "over seventy minutes without either fish coming to the surface," in the London Zoological Gardens. Although he states that these fish came from the Burnett River (1906, p. 169) it is definitely known that they came from the Mary River. In 1906 he reported that lung-breathing took place at irregular intervals, from forty to sixty minutes. Semon saw his Burnett River specimens "appear at the surface every thirty or forty minutes" (1899, p. 92), and this is endorsed by Baldwin Spencer (1927, p. 250). Bancroft, however, points out that lung-breathing is very rare, and that one may watch for a whole afternoon without seeing it. There may be some variation between the Burnett and the Mary River specimens in this respect.

The adult Ceratodus from the Burnett in the large aquarium in the Queensland Museum, which were presented by Dr. T. L. Bancroft, have been rigidly watched on several occasions by relays of observers, and it may be definitely stated that all four specimens may remain beneath the surface from 9 a.m. to 5 p.m. The plate-glass front gives the maximum opportunity for observation, and it is obvious from years of experience here that in the hours of daytime the Ceratodus very rarely rise to the surface. As exhibits of lung-fishes they are in this respect most disappointing, especially in view of statements

in several text-books. It must be recorded, however, that they are living in perfectly clear water, with a sandy bottom. At feeding times or when mechanically disturbed they will frequently rise to the surface to breathe. At night, when they are much more active, they use the lung occasionally, but no maximum period can be given. In the daytime, except when feeding, they normally lie motionless on the bottom, and the greater part of their lives is passed in this condition. These observations confirm the remarks of several writers who consider that the lung is an auxiliary organ, which is chiefly used when the water is muddy or foul. Semon (1899, p. 93) quotes the experience of Mr. W. B. Maltby, of Gayndah, who found Ceratodus in excellent condition in a shallow waterhole in which mullet, perch, or other fish had died.

The slight noise, "spouting," made by the Ceratodus when emitting air at the surface has frequently been noted. This usually resembles a blast from a small bellows, and is chiefly noticeable in the silence of night. Possibly giant specimens may be responsible for the louder noise noted by Illidge and Semon.

Aquatic Breathing.—Ceratodus can obviously breathe through the nostrils when the mouth is closed, but they usually breathe directly through the mouth, and the movement of the lower jaw may be clearly seen. In 1876 Huxley pointed out that in Ceratodus, as in Lepidosiren, "the anterior nasal apertures were truly outside of the mouth, whereas Gunther had previously stated that these were "within the cavity of the mouth." On this minor anatomical point Huxley was right, as usual, for the external nasal opening may be seen from below when the mouth is closed. The aquatic breathing of adults is very variable, as noted by Bashford Dean (1912). This doubtless depends partly on temperature, but also on the activity or otherwise of the specimens. In the same aquarium at the same time our counts varied—26, 31, and 35 per minute for three specimens. When clearing the gills of extraneous matter, after feeding on corn, for instance, they frequently make two or three breathing movements in quick succession. When watched closely it is seen that the mouth is slightly opened with each inhalation. When the fish are mechanically disturbed aquatic breathing is much accelerated. Bashford Dean's excellent account of the rhythmic movements in breathing leaves little for other observers to add. When quiescent in water at a temperature of 65 deg. F. he noted breathing "about twelve times a minute."

In May 1926, three specimens were sent from Eidsvold to the Queensland Museum in wooden boxes filled with water-weeds. These were out of the water at least twenty-one hours, although water was poured over the weeds several times en route. When placed in the aquarium it was noted that the aquatic breathing was very rapid at first, being fifty times to the minute.

Food.—Baldwin Spencer (1892, p. 84) stated that the alimentary canals of Ceratodus examined by him in September were "filled with the fruit of the gum-tree *Eucalyptus terticornis* which overhangs the river bank." This material was uncrushed. W. Macleay had previously reported that the flowers

of *Eucalyptus* were eaten (1884, p. 211). Thomas Illidge (1894) notes that Ceratodus will take snails, worms, and moss, and that a shrimp forms the best bait for catching them on a line. Semon (1899) caught his Ceratodus with baits of meat or molluscs. He suggests that they eat water plants because of the shellfish and other little animals harboured by vegetable growth. O'Connor fed his specimens "mainly on prawns."

The adult specimens in the Queensland Museum feed readily on small pieces of raw beef. They will also devour water-weeds, lettuce, and apples, being evidently fond of the latter. Apples cut into small pieces were found useful, as the water was not easily fouled by decaying remnants. Following a suggestion from Dr. T. L. Bancroft, corn (maize) was put into the aquarium and this was relished. To our surprise, small fragments of crushed corn were occasionally expelled through the gill openings. Sweet potatoes, cut into small pieces, are also eaten, and food which was not taken in the daytime was usually finished at night.

Apparently the Ceratodus obtain their food more by smell than by sight, and in this connection it is interesting to note the unusual development of the olfactory lobes of the brain, recorded by Huxley (1876) and by several subsequent writers.

E. Ray Lankester quotes an interesting account by Dr. Bohls of the natural history of *Lepidosiren* (1894, pp. 11-12). The South American Lungfish cannot be taken on a line, and it feeds chiefly on a large marsh-snail, although vegetable matter is also taken.

Habits.—The first description of the habits of Ceratodus in captivity was given by E. P. Ramsay (1876), when living specimens were received at the Australian Museum from Maryborough. Ramsay's concise statement showed that Ceratodus was a sluggish fish which could not progress out of the water, which mainly used its tail when swimming, and which fed on worms, snails, and water-weeds.

C. Lumholtz (1889, p. 385) made the grotesque statement that at night Ceratodus "goes ashore, where it eats grass and leaves, while in the daytime it may be seen sunning itself on logs lying out of the water."

Baldwin Spencer (1892, p. 82) wrote, "The Ceratodus always stays in the deep pools." He pointed out that, unlike its ally *Protopterus*, it made no cocoon of mud during a season of drought, and the lung was useful as a "subsidiary organ of respiration." Unless surrounded with damp moss or weeds it only lived for eight or ten hours when taken out of the water.

Semon noted that the fish "avoids the river heads" and is "easily affected by sea water" (1899, p. 90). He describes it as "an uncommonly dull, slow, and lazy fish," and he compares its behaviour with that of a newt.

Illidge (1894, p. 41) writes, "After capture it is really the quietest fish I have ever seen." He notes the "fine oily substance" covering the scales, and the greenish-brown appearance of the back and a slaty colour on the belly in life.

In his two articles (1906 and 1912) on the Ceratodus in the Zoological Gardens in London, Bashford Dean gives a full and interesting account, with excellent sketches of its contours in various positions. He states that "its general behaviour suggests that of an amphibian, e.g. *Necturus,*" and his subsequent remarks regarding its movements and feeding habits confirm this likeness to amphibians. He notes that the eyesight is poor and that the fish is "largely nocturnal in habits."

The best concise account of Ceratodus is that given by Sir Baldwin Spencer in "The Encyclopædia of Australia" (1927, pp. 248-250), but the statement regarding the use of the lung, following Semon, requires qualification, as shown elsewhere.

An excellent coloured plate of Ceratodus is given in "Fishes of Australia," by T. C. Roughley (1916, p. 192).

In 1916 T. Harvey Johnston listed three endoparasites from Burnett River specimens.

Ceratodus Totally Protected.—D. O'Connor stated (1898, p. 493) that in the early days the Ceratodus was used as food by settlers and miners, being mostly killed by dynamite. It is of interest to point out that the Ceratodus is now totally protected under "*The Fish and Oyster Act of* 1914."

Nomenclature.—In 1870 Krefft described the Queensland Lung-fish as a Ceratodus, having shrewdly recognised that the dental plates of this "gigantic amphibian," as he called it, were similar to the fossil forms described by Agassiz under that name. The specific name *forsteri* was given "in honour of its discoverer, the Hon. William Forster." A. Smith Woodward in 1890, when describing *Gosfordia* from the Hawkesbury series, pointed out that the Queensland fish would probably need a new name owing to its generic distinction from fossil species.

It is now generally recognised that the present-day Queensland Lung-fish and also the dental plates found in relatively recent deposits are generically distinct from those included in the genus *Ceratodus,* founded by Agassiz in 1838 for Triassic and Jurassic species. Owing to the introduction of the name "Neoceratodus" by Castlenau in 1876 for a fish, said to have come from the Fitzroy River, which he named "Neoceratodus blanchardi," some confusion has existed as to the generic name of our species. The status of Castlenau's fish is in doubt, and some of his work was so unreliable that little confidence can be placed in it. It may be mentioned that he established "Ompax spatuloides"—which Jordan suggests (1819, p. 399) may be based on *Epiceratodus*—on the sketch of a fish which had previously been eaten. Macleay (1882, p. 348) doubted the finding of this fish. In Comptes Rendus, vol. 82, 1876, p. 1034, a communication from Castlenau was read in which he distinctly expresses the opinion that his Fitzroy fish "Neoceratodus" was generically distinct from the Burnett River Ceratodus. Unfortunately the original description of the genus (Journ. Zoologie, v, p. 132) is not available here, but according to the Zool. Record (1876, Pisces, p. 7) a second reference denotes that Castlenau considered his

fish to be a juvenile Ceratodus (*loc. cit.*, p. 343). Although listed as "Neoceratodus" by many ichthyologists, we have followed Baldwin Spencer and later writers on fossil remains in using Teller's genus *Epiceratodus*, established in 1891 for the recent Lung-fishes. Baldwin Spencer emphatically remarks (1925, p. 249) that Castlenau's "description of its teeth alone proves conclusively that it [Neoceratodus] is quite distinct from the Ceratodus of the Burnett and Mary Rivers."

"Ceratodus miolepis."—In 1871 Gunther considered that remarkable differences existed between the Mary River and Burnett River Lung-fishes, and he named the former *Ceratodus miolepis*. He then considered that *C. forsteri* was distinguished by the presence of only eighteen series of scales around the body, whereas twenty-one were found in *miolepis* (p. 516). In his "Challenger" report in 1880, however, Gunther found considerable variation with a far larger series of specimens (p. 32). A. B. Meyer in 1875 considered that the two species should be united, owing to the variation in Gunther's supposed diagnostic character.

Mr. Tom Marshall and I have examined numerous specimens of Ceratodus from the Burnett River, and much variation was found. There may be six series of scales above the lateral lines, and a total of twenty may be counted around the middle part of the body. It seems obvious that Gunther's species cannot stand on this character. Intensive study, however, may show that the Ceratodus from the Burnett watershed may be distinct in certain characters from those of the Mary River and tributaries. Possibly the discrepancies noted in accounts of the habits of these Lung-fishes may be due to physiological differences in specimens from the two distinct habitats. With the exception of the juvenile specimens, which are the progeny of those transported by D. O'Connor from the Mary River in 1895, practically all of our material is from the Burnett River (some of the specimens in the "old collection" are without data), and no adequate comparison can be made at present.

In their list of Queensland Fishes, McCulloch and Whitley (1925, p. 131) recognise but one species, and they note that Macleay's extension of the range of the Lung-fish to the Dawson River was incorrect.

Common Name.—Krefft, Semon, Baldwin Spencer, and Thomas Illidge refer to the Lung-fish as the "Burnett Salmon" of settlers. Although Krefft heard that the "Salmon" was "excellent eating," it seems that this name was given on account of the colour and not the palatability of its flesh, for Ceratodus are by no means appreciated by connoisseurs. The alternative name Barramundi ("Baramoonda" or "Baramoondi," Krefft) is more correctly applied to *Scleropages leichhardti* of the Fitzroy and Dawson, although this name is now commonly used by fishermen for the "Palmer," *Lates calcarifer*. Semon states (1899, p. 18) that the natives on the Burnett called Ceratodus "Djellah," whilst O'Connor gives the aboriginal name "Teebine" (1898, p. 493) for the Mary. Theebine—the modern rendering—is the name of a township on the Mary River, and in October, 1922, the name "Ceratodus" was given to a railway station

and settlement on the Burnett. The authorities have thus given prominence to both the native and the original scientific names of the Lung-fish. As a matter of fact the term "Ceratodus" is now widely used in Queensland as the common name of the Lung-fish, and so the old generic name, now replaced by *Epiceratodus,* is still in vogue.

Fossil Ceratodus.—Apparently the Dipnoi attained their greatest development in Devonian times. The genus *Ceratodus* first appeared in the Permian, according to E. D. Cope. Examples have been found in Europe, India, Africa, and America. The restricted genus *Epiceratodus* is recorded from the Upper Cretaceous by E. I. White (1926, p. 677). The genus *Gosfordia,* which may represent an allied form from the Lower Hawkesbury Beds (Triassic), Gosford, N.S.W., was described by A. Smith Woodward in 1890. The following references to fossils found in Australia may be useful:—

Gerard Krefft gave the name *Ceratodus palmeri* to a dental plate from alluvial deposits on the Darling Downs, which he considered larger than that of *C. forsteri* (1874, p. 293).

In 1884 De Vis wrote a short paper on several dental plates of Ceratodus which had been found on the Darling Downs. These included the type of Krefft's *Ceratodus palmeri* (p. 42), which had been submitted to Mr. Krefft. De Vis considered that this material was not specifically distinct from the existing Queensland species. Subsequently a dental plate of Ceratodus was obtained "at a depth of about 70 ft. from a well sunk in the Eight-mile Plains near Brisbane" (Jack and Etheridge, 1892, p. 647).

From the Lower Jurassic cliffs of Cape Patterson, Victoria, A. Smith Woodward described *Ceratodus avus* from a lower tooth with four denticles (1906, pp. 1-3). F. Chapman (1912, p. 234) subsequently associated a scale from Jurassic sandstone at Kirrak, S. Gippsland, with this species.

In 1921 W. S. Dun exhibited before the Royal Society of N.S.W., "Teeth of a Ceratodus from late Tertiary deposits at Wentworth" (1922, p. liv). Baldwin Spencer notes teeth from the dry bed of a lake near Wilcannia (1927, p. 248).

Frederick Chapman described *Ceratodus wollastoni* from the Upper Cretaceous of Walgett, N.S.W., from a lower tooth with four denticles. He instituted the sub-genus *Metaceratodus* for this material (1914, p. 25).

In 1925 E. I. White described two new fossil species of *Epiceratodus* (*eyrensis* and *gregoryi*) from the Lake Eyre district of South Australia. These were first noted by Professor J. W. Gregory (1906, p. 81), who also added a note on the geology of Lake Eyre to Mr. White's descriptions (1925, pp. 144-145).

Epiceratodus pattinsonæ from the Opal Beds, White Cliffs, N.S.W., Upper Cretaceous, was described by E. I. White in 1926, and this is stated to be the earliest recorded specimen of the genus, as restricted (1926, p. 677).

Stromer and Peyer (1917, p. 76) have noted several characters by which the teeth of *Epiceratodus* may be distinguished from those of *Ceratodus*. The later forms have an increased number of radiating ridges, six being present in *Epiceratodus forsteri*. Although the edges of these ridges, or combs, are not crenulated as in many fossil Dipnoi, Semon has shown that in the embryo there are distinct small conical teeth which become fused in development (Figure 210b, Goodrich, 1909, p. 242).

One splenial dental plate in our collection from an adult *Epiceratodus* is exceptional in having but five ridges.

Two of our fossil dental plates from the Darling Downs are far larger than any obtained from present-day fish. The maximum length across the ridges in the fossil plates attains 57 mm., whereas in a Lung-fish 44 inches in length from the Burnett River the maximum for the dental plate is only 37 mm. Probably *Epiceratodus palmeri* will prove to be a good species, and it evidently attained a large size. Both the large dental plates mentioned are from the lower jaw. Miall's study of the dental plates of *Ceratodus polymorphus* illustrates the variability of some of the fossil species (1878).

D. M. S. Watson and E. L. Gill consider that the genus *Sagenodus* of the Lower and Upper Carboniferous and Lower Permian is essentially ancestral to *Ceratodus* (1923, p. 215).

Anatomical Work.—In Huxley's words the Dipnoi "are nearly transitional forms between the Pisces and the Amphibia," and it is not surprising that, as one of the three living representatives of the Dipnoi, *Epiceratodus forsteri* has been the subject for extensive research by numerous specialists. No adequate tabulation can appropriately be given here of the voluminous researches, but some references in addition to those already given are noted, mainly for the use of local students.

Gunther's monograph in the Philosophical Transactions of the Royal Society appeared in 1871, and Huxley's paper (P.Z.S.) in 1876. Some of Semon's work has already been mentioned.

In consonance with the development of an occasionally functioning lung the heart and blood-vessels of Ceratodus have been modified from the ordinary fish type. Baldwin Spencer's finely illustrated paper on "The Blood Vessels" appeared in the Macleay Memorial Volume (1893). A figure of the heart is given by E. S. Goodrich (1909, p. 250).

The leaf-like fins of Ceratodus with their skeletal supports form an archipterygium, and special work on these structures has been done by Gunther, Huxley, Semon, Gegenbaur, Balfour, and Haswell.

Writing of the brain, E. S. Goodrich (1909, p. 245) says that "few organs in the Dipnoi so clearly show the isolation of this sub-class from other fish." Recently additional work on the brain of Ceratodus has been done by Nils Holmgren and C. F. van der Horst (1925).

Many references to special research on the Dipnoi are given in E. S. Goodrich's valuable text-book on Vertebrata Craniata (1909), which itself contains many figures illustrating the anatomy of *Epiceratodus*.

LITERATURE CITED.

1911.—Bancroft, T. L. A Weak Point in the Life-history of *Neoceratodus forsteri*. Pr. Roy. Soc. Qld., vol. xxiii, pp. 251-256.

1913.—Bancroft, T. L. An Easy Method of Hatching Ceratodus Ova. Pr. Roy. Soc. Qld., xxv, pp. 1-3.

1918.—Bancroft, T. L. Further Notes on Life-history of Ceratodus. Pr. Roy. Soc. Qld., xxx, pp. 91-94.

1924.—Bancroft, T. L. Suggestion for a Biological Laboratory on Stradbroke Island for the Protection of Ceratodus. Pr. Roy. Soc. Qld., xxxvi, pp. 19-20.

1885.—Caldwell, W. H. Development of the Monotremes and Ceratodus. Jr. & Proc. Roy. Soc. N.S.W., xviii, p. 119.

1887.—Caldwell, W. H. Phil. Trans. Roy. Soc., vol. 178, p. 465.

1876.—Castlenau, F. de. *Neoceratodus*. Journ. Zool. (Gervais), v, pp. 129-136, *id. loc. cit.*, p. 343. (Zool. Rec., 1876, Pisces, p. 7.)

1876.—Castlenau, F. de. Comptes Rendus, vol. 82, p. 1034 (Note on Ceratodus communicated by Gervais), 24th April.

1879.—Castlenau, F. de. Ompax. Pr. Linn. Soc. N.S.W., vol. 3, p. 164.

1912.—Chapman, F. Jurassic Sandstone with Ceratodus. Rec. Geol. Surv. Vict., iii, pt. 2, pp. 234-235, pl. xxxix.

1914.—Chapman, F. Ceratodus from the Cretaceous of N.S.W. Proc. Roy. Soc. Vict., 27 (n.s.), pp. 25-27, pl. v.

1884.—Cope, E. D. Proc. Amer. Phil. Soc., p. 28 (*Ceratodus favosus;* Permian, Texas).

1906.—Dean, Bashford. Notes on Living Specimens of the Australian Lung-fish . . . P.Z.S., pp. 168-178, pl. ix.

1912.—Dean, Bashford. Additional Notes . . . P.Z.S., pp. 607-612.

1922.—Dunn, W. S. Jr. Pr. Roy. Soc. N.S.W., lv, p. liv.

1909.—Goodrich, E. S. Treatise Zoology. Pt. ix, Vertebrata Craniata.

1906.—Gregory, J. W. The Dead Heart of Australia, p. 81.

1871.—Gunther, A. Description of Ceratodus. Phil. Trans. Roy. Soc., vol. 161, pp. 511-571, plates 30-42.

1880.—Gunther, A. Challenger. Zool., vol. i, p. 32 (Report on Shore Fishes).

1883.—Haswell, W. A. On the Structure of the Paired Fins of Ceratodus. Pr. Linn. Soc. N.S.W., vii, pp. 2-11, pl. 1.

1925.—Holmgren, N., and Horst, C. F. van der. Contributions to the Morphology of the Brain of Ceratodus. Acta Zoologica, bd. vi, pp. 59-165.

1876.—Huxley, T. H. On *Ceratodus forsteri*. (Con. to Morph.), P.Z.S., pp. 24-59.

1894.—Illidge, Thomas. On *Ceratodus forsteri*. Proc. Roy. Soc. Qld., vol. x, pp. 40-44.

1892.—Jack, R. L., and Etheridge, R. Geology and Palæontology, Queensland, p. 646.

1915.—Johnston, Harvey T, and Bancroft, T. L. Exhibit of Ceratodus. Proc. Roy. Soc. Qld., vol. xxvii, pp. 58-59.

1916.—Johnston, Harvey T. Proc. Roy. Soc. Qld., xxviii, p. 62 (Endoparasites listed).

1919.—Jordan, Starr D. The Genera of Fishes. Pt. iii, Stanford University.

1870.—Krefft, G. Description of a gigantic Amphibian allied to the Genus Lepidosiren, from the Wide Bay district, Queensland. P.Z.S., pp. 221-224.

1874.—Krefft, G. *Ceratodus palmeri*. Nature, ix, p. 293.

1894.—Lankester, Ray E. *Lepidosiren* and *Protopterus*. Trans. Zool. Soc., 1894, xiv, pp. 11-12.

1918.—Longman, H. A. Pr. Roy. Soc. Qld., vol. xxx, p. xi.

1889.—Lumholtz, C. Among Cannibals. London.

1882.—Macleay, W. Ompax. Pr. Linn. Soc. N.S.W., vi, p. 348.

1884.—Macleay, W. Pr. Linn. Soc. N.S.W., viii, p. 211.

1875.—Meyer, A. B. *Ceratodus forsteri* and *miolepis*. Ann. Mag. Nat. Hist (4), xv, p. 368.

1878.—Miall, L. C. *Ceratodus polymorphus*, &c. Monograph Palæontographical Society, London.

1925.—McCulloch, A. R., and Whitley, G. P. List of the Fishes recorded from Queensland Waters. Mem. Qld. Mus., vol. viii.

1897.—O'Connor, D. Report on Preservation of Ceratodus. Proc. Roy. Soc. Qld., xii, pp. 101-102.

1898.—O'Connor, D. P.Z.S., p. 493.

1898.—O'Connor, D. Qld. Agric. Journ. iii, pp. 173 and 238 (Note on transit to England of four live Ceratodus from the Mary River).

1910.—O'Connor, D. Notes on the Ceratodus. Aus. Assn. Adv. Sci., xii, pp. 383-384.

1912.—Ogilby, Douglas J. Mem. Qld. Mus., i, p. 65.

1876.—Ramsay, E. P. P.Z.S., p. 698.

1916.—Roughley, T. C. Fishes of Australia. Technological Museum, Sydney.

1876.—Schmeltz, J. D. E. Journ. Mus. Godeffroy, vol. viii, p. 138.

1893.—Semon, Richard. *Ceratodus forsteri*. Zoolog. Forschungsreisen, i, Jena, pp. 1-50, pl. i-viii.

1899.—Semon, Richard. In the Australian Bush. Eng. Edit. London.

1892.—Spencer, Baldwin W. A Trip to Queensland in Search of Ceratodus. Vict. Nat., vol. ix, pp. 16-32.

1892.—Spencer, Baldwin W. Note on the Habits of *Ceratodus forsteri*. Proc. Roy. Soc. Vict., vol. iv, n.s., pp. 81-84.

1893.—Spencer, Baldwin W. The Macleay Memorial Volume, pp. 1-34, pl. i-v.

1927.—Spencer, Baldwin W. Ceratodus. The Australian Encyclopædia, Angus and Robertson, Sydney, vol. i, pp. 248-250, pl. xii. (Third edition.)

1917.—Stromer, E., and Peyer, B. Zeit. deutsch. geol. Gesell., lxix, pp. 1-80 (*Epiceratodus*).

1891.—Teller, F. *Epiceratodus*. Abh. Geol. Reichsanstalt, Wien, xv, heft 3, p. 37.

1923.—Watson, D. M. S., and Gill, E. L. Journ. Linn. Soc. Zool., xxxv, pp. 163-216.

1905.—Welsby, Thomas. Schnappering and Fishing. Brisbane, pp. 175-190.

1925.—White, E. I. Fossil *Epiceratodus*. Ann. Mag. Nat. Hist., (9) vol. 16, pp. 139-146, pl. vi and vii.

1926.—White, E. I. *Epiceratodus* in Upper Cretaceous of N.S.W. Ann. Mag. Nat. Hist. (9) vol. 17, pp. 677-682.

1890.—Woodward, Smith A. Mem. Geol. Surv. N.S.W., Pal. No. 4, p. 5.

1891.—Woodward, Smith A. Catal. Fossil Fishes. Brit. Mus., pt. ii.

1906.—Woodward, Smith A. Ceratodus from Lower Jurassic, Vict. Ann Mag. Nat. Hist. (7) 18, pp. 1-3, pl. i.

NEW SPECIES AND RECORDS OF AUSTRALIAN TINGITOIDEA (HEMIPTERA).

By Henry Hacker, F.E.S.

(Plates XX—XXIII.)

The following contribution is based on the study of a collection belonging to the South Australian Museum, and the writer here tenders his thanks to that institution for the loan of this material. Most of the specimens were collected by Arthur M. Lea, who has discovered some remarkable new species, several of which he found in ant-nests. Inquilinous habits among Tingitid bugs have not, I believe, been previously recorded, and further examinations of ant colonies should greatly increase our knowledge of these interesting insects. With the exception of one species, all the holotypes have been returned to the South Australian Museum. Where the material is sufficient, paratypes have been deposited in the Queensland Museum.

Subfamily CANTACADERINÆ.

CANTACADER A. et S.

The four species mentioned here do not strictly conform to the characters of the genus, as given by Champion and Distant. They possess but three well-developed pronotal carinæ; the abbreviated but sharply defined outer ones, usually present in species of other countries, are either absent or represented by hardly distinguishable scar-like marks. In *C. armatus* a small scale-like scutellum is present, and *C. leai* has a moderately large triangular one; the length of rostrum varies considerably in the different species. In their elongate heads, head spines, and general facies, however, they resemble typical members of the genus, so are included here.

Cantacader cordatus (Hacker).

Phatnoma cordata Hacker. Mem. Queensl. Mus. IX., p. 19, 1927.

There is a short and obscure keel on each side of the pronotum, close to the lateral margin, which I had previously overlooked.

Cantacader armatus n. sp.

(Plate XX, Figure 1.)

Head armed dorsally with four stout acutely pointed spines which are slightly divergent and upwardly curved; antennæ long and slender, segment I moderately stout and cylindrical, about twice as long as the second; III very long and slender; IV, fusiform, about as long as the first and second

conjoined; buccal lamina elongate, meeting beyond the front of the head; the rostrum reaches to the posterior coxæ. Pronotum rather coarsely punctured, tricarinate, the carinæ strongly raised, uniareolate; the lateral carinæ are narrowly interrupted towards the front, and then converge, forming the sides of a narrow somewhat depressed hood, which covers the base of the head between the eyes; pronotum narrow anteriorly, widening towards the base; the sides dilated, cellular, and armed with seven or eight acute spines directed outwardly; the spine at the anterior angle, and another about one-third from the base, are much larger than the others; behind the latter spine the margin is more widely dilated. Elytra sub-cordate, rather deeply emarginate posteriorly; lateral margins strongly raised and slightly compressed; a raised longitudinal line with four transverse branches on the outer side; on the inner side the branches join another raised line along the suture, dividing the discoidal area into three closed cells; areolæ of moderate and even size; legs slender.

General colour brownish ochraceous; a narrow interrupted transverse fascia on the elytra before the middle, the tips of the outer transverse veins on the elytra, and spots on the lateral margin, dark fuscous; scattered reticulations on the elytra, brown; antennal segment IV, blackish; legs brown with a paler annulation near the apex of the femora; eyes ruby. Length 4·5 mm., breadth 2·25 mm.

Holotype.—Murray Bridge, South Australia (A. M. Lea). *No. 16877.*

Paratypes.—Same data. In the Queensland Museum. *He. 3268.*

Cantacader dentatus n. sp.

(Plate XX, Figure 2.)

Head and spines similar to those of *C. armatus*; antennal segments I and II also similar, the other segments are missing; the rostrum extends slightly beyond the posterior coxæ. Pronotum truncate anteriorly, and the sides are less dilated than in the previous species; the lateral margins are slightly sinuate and armed with about six short dark spines on each side. Elytra very broad, widely rounded anteriorly and laterally, angularly rounded and emarginate posteriorly; costal area broad, with five rows of moderate-sized areolæ; it is strongly raised and the anterior half is recurved (rolled).

Colour brownish ochraceous, with a few small darker spots on the elytra; a transverse irregular fascia on the costal area before the middle, a spot at the apex of the elytra on the inner side, and the pronotal spines, blackish; legs and underside brown; each abdominal segment has an obscure transverse darker band. Length 3·5 mm., breadth 2 mm.

Holotype.—Burnie, Tasmania (A. M. Lea). *No. 16878.* (Unique.)

The rolled-up sides of the elytra and the row of small spines on each side of the pronotum readily separate this form from the other described species.

Cantacader leai n. sp.

(Plate XX, Figure 3.)

Head very elongate, armed above with four blunt tuberculate spines arranged in two pairs; antenniferous tubercles spine-like, well developed; bucculæ not projecting prominently in front of the head, separated anteriorly exposing the rostrum; from side view the head is rounded in front; the rostrum extends to the fifth abdominal segment; antennæ moderately long; segment I very thin at the point of attachment, then stout, a little longer and stouter than II; III very thin at the point of attachment, suddenly becomes stout, and gradually tapers towards the apex; IV sub-fusiform, stouter towards the apex which is pointed, thinly pilose; eyes prominent. Pronotum transversely depressed in the centre, rising towards the margins, reticulated except centrally, with small areolæ; the anterior margin is concavely curved and slightly raised; the lateral margins are without spines, their anterior and posterior angles rounded; the base is slightly obtuse; the median carina is sharply defined; the lateral carinæ are less strongly developed and rather widely interrupted before the middle; scutellum distinct, triangular, smooth. Elytra broad-ovate, closely covered with minute even areolæ; the discoidal area is divided by a strong longitudinal vein, and several weak transverse veins; the costal area is wide, five to six rows areolate, raised towards the outer margin; the elytra are slightly separated along the suture, coming together and touching near the apex. Legs slender.

General colour pale luteous, immaculate; head, and the pronotal disc transversely, ferruginous brown; femora brown; tibiæ, tarsi, and the antennæ, lighter brown; rostrum, and the ventral surface, yellowish brown; eyes ruby. Length 3 mm., breadth 1·5 mm.

Holotype.—Hobart, Tasmania (A. M. Lea), labelled "Inquiline." *No. 16879.*

Paratypes.—Dunorban, Tasmania (A. M. Lea). Together with two nymphs, and the host ant,[1] *Amblyopone australis* Erich.

Bright, Victoria (H. W. Davey). From an ant-nest. *He 3269.*

Phatnoma pacifica Kirk.

(Plate XX, Figure 4.)

Habitat.—Cairns District, N. Queensland (A. M. Lea).

This is the first record from Australia for *P. pacifica* Kirk, which was described by Kirkaldy[2] from specimens obtained at Viti Levu, Fiji. It has not previously been figured.

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[1] The two ants mentioned in this paper were determined by J. Clark.

[2] Proc. Linnean Soc. N.S.W., xxxiii, p. 363, 1908.

Phatnoma tindalei n. sp.

(Plate XXI, Figure 5.)

Head moderately long, armed with four blunt semi-erect spines, two medially and two anteriorly; antenniferous tubercles convexly produced into a curved spine; antennæ moderately long, segment I stouter and one and a half times longer than II; III slender, stoutest near the base; IV fusiform and thinly pilose, about as long as I and II conjoined; the bucculæ project prominently in front of the head; the rostrum reaches to the first abdominal segment; eyes prominent. Pronotum rather coarsely punctured, depressed on the disc, tricarinate, the lateral carina narrowly interrupted before the middle; the anterior margin is close to the base of eyes, truncated, and slightly raised; lateral margins slightly sinuate, anterior and posterior angles acute. Elytra strongly convex; the lateral margins in front continue in a line with the sides of pronotum, convexly curved, widest in the middle, and rounded posteriorly; longitudinal and transverse veins in discoidal area strongly raised, enclosing a large hexagonal area in the middle; several branches extend from the longitudinal vein to the costal membrane, which is biseriate areolate.

Colour brownish ochraceous; a smooth transverse fascia through the depressed pronotal disc, and antennal segment IV, black; irregular mottling, chiefly on discoidal and sutural areas, and a spot on the costal membrane near the middle fuscous; the carinæ are lighter in colour, and those on the elytra have a distinct reddish tint; head ferruginous, spines pale; antennæ and legs ochraceous, the femora slightly darker. Length 2·25 mm., breadth 1·25 mm.

Holotype.—Mount Lofty Ranges, South Australia (N. B. Tindale). In moss and lichens. *No. 16886.*

Paratypes.—Myponga, South Australia (A. H. Elston). Mount Lofty (R. J. Burton). In moss, Belgrave, Victoria (F. E. Wilson). *He. 3270.*

In its narrower costal area and unarmed pronotum this species differs considerably from *P. pacifica* Kirk, and has a much closer resemblance to the South African species *P. æthops* Dist. and *P. testacea* Dist.

SUBFAMILY TINGITINÆ.

Oncophysa vesiculata Stål.

Habitat.—Victoria (A. M. Lea). Donnybrook, Western Australia (A. M. Lea).

According to Horvath,[3] the brown forms from Lamington Plateau, Queensland, are typical of this species. There are two further forms, whether they be varieties or races, which may be readily separated according to the large series before me by the following characters :—

[3] Arkiv för Zoologi, band 17A, p. 2, 1925.

Oncophysa vesiculata var **nigra** n. var.

(Plate XXI, Figure 6.)

Entirely black, including the head spines, bucculæ, antennæ, and legs. In a bright light the median carina and the eyes appear slightly reddish. Length 4·75 mm., breadth 1·375 mm.

Holotype.—Mount Arthur, Tasmania (F. M. Littler). *No. 16881.*

Paratypes.—Hobart and Burnie, Tasmania (A. M. Lea). Millgrove, Victoria (F. E. Wilson). *He. 3276.*

From the published localities, it would appear that the typical form occurs from South Queensland throughout New South Wales; the typical form and var. *nigra* both occur in Victoria; while in Tasmania var. *nigra* only is present.

Oncophysa vesiculata var **gracilis** n. var.

(Plate XXI, Figure 7.)

Slightly smaller than the typical form; length 4 mm., breadth 1 mm.; the reticulations are finer and less strongly raised, the vesicles are smoother and shining.

General colour fulvescent; head and eyes ferruginous; collum and pronotal carinæ flavous; reticulations on the pronotal vesicles and elytra, orange rufous; legs, body beneath, and antennal segments I, II, III, fulvescent; segment IV, black.

Holotype.—Cape Jarvis, South Australia (H. M. Hale). *No. 16882.*

Paratypes.—Same data, and Adelaide, South Australia (N. B. Tindale). *He. 3277.*

Oncophysa rufescens n. sp.

(Plate XXI, Figure 8.)

Head with two spines basally at sides, and three minute spines, one in the middle, and two close together near the base of the antennæ; antennæ moderately long, segment I stout and cylindrical; II slightly shorter and thinner than the first; III long and slender; IV clavate and thinly pilose. Pronotum tricarinate, the carinæ paralleled on the posterior angle; anteriorly the lateral carinæ are covered by the large reflexed paranota, which extend to the median carina, and are swollen into a large vesicle on each side. Elytra longer than the abdomen, reticulate; costal membrane narrow, uniseriate; costal area biseriate; the areolæ are all of even size, and do not become larger on the sutural area posteriorly.

General colour reddish brown; reticulations on the pronotal vesicles and the elytra, distinctly reddish; elytra paler basally, a pale suffusion at the apex of the discoidal areas, and the bucculæ, ochraceous brown; pronotal

carinæ light rufous; head ferruginous; antennal segments I and II ferruginous brown; segment III, and the tibiæ, testaceous; segment IV except narrowly at the base, black. Length 3 mm., breadth 1 mm.

Holotype.—Port Noarlunga, South Australia (N. B. Tindale). *No. 16883.*

Paratypes.—Same data, and Adelaide (N. B. Tindale). Sea beach. *He. 3272.*

Readily distinguished from *O. vesiculata* Stal and its varieties, by the shorter and slightly stouter build, and reddish colour, paler at the base of the elytra, and at the apex of the discoidal areas.

Hypsipyrgias telamonides Kirk.

Habitat.—Cairns District, North Queensland (A. M. Lea).

The examination of a series of this species from different localities shows some variation in the shape of the pronotal vesicle. In the Brisbane forms, when viewed from the side, the anterior border rises almost perpendicularly to the top of the vesicle. In those from Cairns, the anterior border is strongly curved forward near the top, as figured by Kirkaldy; but among this series are others resembling the southern forms.

Diplocysta bilobata Horv.

Habitat.—Swan River, Western Australia (A. M. Lea). One specimen in a rather mutilated condition.

Diplocysta globuliformis n. sp.

(Plate XXII, Figures 9, 10.)

Head armed with five slender porrect spines; two basally at sides, subparallel; one medial, and two close together in front, converging and touching; antennal segment II slightly shorter and thinner than the first, both very short; III filiform, three and a half times longer than the fourth; IV fusiform and longer than the first and second conjoined; bucculæ rather prominent, from side view sharply rounded in front; the rostrum reaches to the intermediate coxae. Pronotum anteriorly truncated, the disc entirely filled with a large and highly elevated dome-like vesicle; seen from above it is circular and somewhat shining, and is composed of large, mostly hexagonal reticulations; viewed from the side it rises in nearly a straight line from the anterior margin; the posterior outline is more convexly rounded; lateral margins widely rounded, with a row of large transverse areolæ; tricarinate on the posterior angle, the carinæ sub-parallel and uniareolate; the median carina is interrupted by the pronotal vesicle; the lateral carinæ continue round its base on each side. Elytra broad, laterally rounded, widest at the middle, and widely rounded posteriorly; costal area biareolate, angulated at apex of discoidal area; costal membrane biareolate, the areolæ uneven in size and shape, the outer row larger than the inner.

Head, and the body beneath, black; pronotal vesicle, paranota and carinæ, yellowish brown; posterior angle of the pronotum, discoidal and

sutural areas posteriorly, fuscous; costal membrane white opaque, with light-brown reticulations at the base and past the middle; the central reticulations and a spot at the apex, fuscous; legs and antennæ brownish testaceous. Length 2·875 mm., breadth 1·25 mm.

Holotype.—Thursday Island (A. M. Lea and C. T. McNamara). *No. 16884.*

Paratype.—Cairns District (A. M. Lea). *He. 3271.*

This species differs from *D. bilobata* Horv. in the shape of the pronotal vesicle and in the costal membrane being irregularly biseriate.

Cysteochila brunnea n. sp.

(Plate XXIII, Figure 13.)

Oblong, moderately elongate.

Head armed with two spines basally at the sides, adpressed and slightly convergent; two small spines close together converging and touching, between the base of the antennæ, and a small central semi-erect spine; antennal segment I short and stout; II slightly shorter and narrower; the other segments missing; bucculæ rather prominent in front, from the side view, angularly rounded; the rostrum reaches to the intermediate coxae. Pronotum very strongly convex; the anterior margin is close to the eyes, slightly sinuated and somewhat raised; hood very small, sharply keeled above and slightly projecting; the disc is covered by the large reflexed paranata which meet along the middle, covering the median carina; the areolæ on the paranota are large and deeply impressed; tricarinate, the lateral carinæ paralleled on the posterior angle, gradually converge towards the disc; the median carina continues in front of the paranota, to the anterior margin. Elytra closely reticulated, the areolæ deeply impressed and smaller than those on the paranota; the lateral margins are almost straight, slightly widened at the middle, which is the same width as the pronotum; discoidal area large, outer margin almost straight; the costal area and costal membrane are very narrow, the former biareolate, the latter uniareolate, with the areolæ in the posterior half slightly larger and hyaline. Legs moderately long and stout.

Colour uniformly fuscous, opaque, excepting a paler central area near the apex of the sutural area; the reticulations on the pronotum are lighter than the membrane beneath; head spines, part of the median carina, second antennal segment, and legs, fulvescent; head and eyes, blackish; body beneath, first antennal segment, and the bucculæ, ferruginous. Length 3·25 mm., breadth 1 mm.

Holotype.—Cairns District (A. M. Lea). Unique. *No. 16885.*

Cysteochila (Parada) tæniophora Horv.

Habitat.—Upper Williams River, N. S. Wales (Lea and Wilson). Mt. Tambourine Q., and Cairns District Q. (A. M. Lea).

Froggattia olivina Horv.

Habitat.—Launceston, Tasmania (F. M. Littler). Hobart, Tasmania (A. M. Lea). Windsor; National Park, N. S. Wales (A. M. Lea).

Monanthia amitna Horv.

Habitat.—Cairns District (A. M. Lea).

Callithrincus serratus Horv.

Habitat.—Cairns District (A. M. Lea). One example.

GYMNOTINGIS n. gen.

Head armed with five slender spines; two basally at the sides, diverging and projecting beyond the eyes, one median, straight and semi-erect, and two in front converging and touching, reaching to the second antennal segment; antennæ slender; segment I cylindrical, half as long again and stouter than the second; III filiform, and slightly curved; IV clavate, about as long as the first and second conjoined; bucculæ closed in front, sides of rostral sulcus sub-parallel; the rostrum reaches to the posterior coxæ. Pronotum moderately convex, finely and closely punctate, tricarinate; the lateral carinæ are more highly raised than the median, biareolate on the disc, and with a rounded projection at their posterior end; the median carina has a rectangular keel-like projection on the disc, and a less prominent rounded projection at the posterior end; the anterior border is strongly sinuate; hood moderate, rather narrow, and sharply keeled above; viewed laterally the anterior border extends over the base of the head, then obliquely truncated, and pointed at the highest part; the paranota are foliaceous, triareolate, roundly laminately produced anteriorly; before the middle they are reflexed and closely adpressed to the pronotum, then suddenly laminately produced and convexly curved posteriorly; viewed from above, the paranota look as though a large U-shaped piece had been cut out on each side. Elytra ovate, constricted behind the discoidal area; the outer boundary of the discoidal area is raised in the middle and at the apex; the lateral margin is multisinuate and microscopically spinose serrulate; costal membrane rather wide, biareolate, the areolæ large and irregular; costal area declivous, biareolate, the areolæ moderate; the discoidal area has four to five irregular rows, the areolæ somewhat larger in the centre; sutural area wide, with areolæ about the same size as the discoidal area. Antennæ and legs moderately long and slender. Wings nearly as long as the elytra.

Type.—G. serrulata n. sp.

In the structure of the paranota and the pronotal carinæ, this genus is very distinct. The paranota in *Acysta interrupta* Champ. bear a remote resemblance, but in that species they are obliterated in the middle, whereas in this genus they are entire, but the central part is bent back close to the pronotum. Among Australian genera it is perhaps nearest to *Callithrincus* Horvath.

Gymnotingis serrulata n. sp.

(Plate XXIII, Figure 14.)

Glabrous; pale brownish ochraceous; paranota and the costal membrane, yellowish, sub-hyaline, with pale-brown reticulations; eyes, and antennal segment IV excepting the extreme base, black; mesosternum, coxæ, and the abdomen beneath, brown; a small spot on the raised part of the discoidal outer border, fuscous; legs and bucculæ, pale ochraceous; structural characters as in the generic diagnosis. Length 3·125 mm., breadth 1·375 mm.

Holotype.—Cairns District (A. M. Lea). Unique. *No. 16886*.

MYRMECOTINGIS n. gen.

Head transverse, with five long slender spines; antennæ widely separated at the base, moderately long, and clothed with setose hairs; bucculæ closed in front, viewed laterally subrectangular in front, short, rather broad, and fringed with short hairs; the rostrum reaches to the intermediate coxæ; eyes prominent. Pronotum moderately convex, clothed with fine pile; tricarinate, the carinæ raised, uniareolate, and furnished with a row of erect spines; hood longer than wide, with rather large areolæ, longitudinally carinate above, and projecting obliquely over the head; paranota short, strongly produced in the middle, with large areolæ; the outer margin is armed with slender spines; posterior angle short and apically rounded; the metasternal orifice is not visible. Elytra longer than the abdomen, thinly clothed with fine hair; broadest at the middle, straight and narrowing behind, and rather acutely rounded apically; the lateral margins are fringed with a row of slender spines; discoidal area very large, bounded by a row of erect spines; costal membrane slightly narrower at the base, hyaline, with a single row of large tetragonal areolæ; wings not visible. Legs moderately long and slender, thinly clothed with setose hairs.

Type.—*M. leai* n. sp.

The above characters, especially the presence of both hair and spines, the finger-like hood, and the long discoidal area, separate this form from any genus known to me. The lateral marginal spines of the paranota and elytra, also those on the carinæ, appear under a high magnification to be hollow and jointed, the part beyond the joint being bristle-like and sharply pointed.

Myrmecotingis leai n. sp.

(Plate XXIII, Figure 15.)

Head with two long slender spines basally at the sides, directed outwards beyond the eyes; one submedial and two in front; the latter three are porrect, and the anterior pair extend parallel between the antennæ, to beyond the first segment; antennæ thinly covered with spinose hairs; segment I thin at the base, then stout and cylindrical; II less stout, and about half the length of the first; III filiform, about three times as long as the fourth; IV subclavate, as long as the first and second conjoined. Pronotal hood with large reticulations bearing scattered hairs, longer than wide, and somewhat truncated

at the top; paranota hyaline, with two rows of large areolæ. Elytra sub-pyriform; the discoidal area extends three-quarters the length of the elytra, the sides slightly convexly curved, with four rows of moderate-sized areolæ; costal area declivous, triseriate; the areolæ on the discoidal, costal, and sutural areas are about the same size.

General colour brownish buff; head, pronotum, and elytra, brown; reticulations, carinæ, and spines testaceous; membrane of hood, and the fine pile on pronotum, whitish; antennal segments I, II, and IV, femora, and the body beneath, brown; tibiæ, and antennal segment III, testaceous; eyes ruby. Length 2·5 mm., breadth 1·25 mm.

Holotype—Swan River, Western Australia (A. M. Lea). Unique. *No. 16887.* Labelled "Inquiline" and originally mounted with specimens of the Dolichoderine ant *Iridomyrmex conifer* Forel.

Tingis spinicollis Horv.

Habitat:—Cairns District (A. M. Lea).

Paracopium australicus (Stal).

Habitat:—Cairns District, Q. (A. M. Lea). Melville Island (W. D. Dodd). Moa Island, Torres Strait (C. T. McNamara). Sydney, N. S. Wales (A. M. Lea).

All these belong to the darker (almost black) form.

Stephanitis queenslandensis Hacker.

Habitat.—Cairns District; Magnetic Island, Queensland (A. M. Lea).

NEOPACHYCYSTA n. gen.

Head transverse, armed with five spines; antennæ long, rather slender, contiguous at the base; bucculæ not prominent, closed in front; rostal sulcus closed behind. Pronotum broad, finely punctured, tricarinate, with foliaceous sub-parallel carinæ; hood moderate, rather narrow and highly elevated, extending over the base of head, truncated in front; from side view, convexly curved above; paranota very broad, shell-shaped, widely dilated, and elevated slightly higher than the hood, inflated and reflexed; the incurved margins and also the pronotal carinæ are fringed with fine pilose hairs; the posterior angle is reticulated and somewhat obtusely rounded apically; metasternal orifices distinct. Elytra broadly ampliated from the base, narrowing beyond the middle, extending far beyond the abdomen; costal membrane wide, with three rows of large areolæ, the outer margin near the base is slightly raised; costal area declivous, with two rows of small areolæ; discoidal area large, occupying half the length of the elytra, with six to seven rows of small areolæ at the widest part; the carinæ dividing the elytral areas are strongly raised; sutural area large, the areolæ basally on the inner side are small, increasing in size apically, the outer row are tetragonal. Wings much longer than the abdomen.

Type.—N. subopaca n. sp.

This genus seems closely related to *Pachycysta* Champ., but the antennæ are not widely separated at the base; the pronotal carinæ do not converge in the middle; the paranota are elevated as high as the hood, which does not extend far enough to cover part of the lateral carinæ. The oblong smooth convex prominence mentioned by Champion, in front of the head, is not present.

Neopachycysta subopaca n. sp.

(Plate XXII, Figures 11, 12.)

Head armed with five slender spines, two basally at sides, one median and two anteriorly, which converge at the base of the antennæ; antennal segment I cylindrical, stouter and half as long again as the second; III slender, three times as long as the fourth segment, which is pilose and longer than the first and second conjoined; the rostrum reaches to the intermediate coxæ. Pronotal carinæ strongly raised, uniseriate, the areolæ large and transverse; hood and paranota reticulated, the areolæ about the same size, those at the base of the hood are slightly smaller. Elytra pyriform; the reticulations are small on the discoidal and costal areas, larger on the costal membrane and the sutural area apically.

Hood paranota and pronotal carinæ, creamy white, sub-opaque, the reticulations varying from pale ochraceous to brown; disc of the pronotum and a spot on the median carina behind the disc, fuscous; the elytra are pale ochraceous with dark markings as follows:—A broad transverse fascia on the costal membrane before the middle, which is broken up into spots in the discoidal area; another fascia near the apex distinct on the costal membrane, becoming obsolete in the middle; a round suffusion at the apex, fuscous; costal membrane whitish opaque, excepting a few outer areolæ which are hyaline; the head, first and second, base of the third, and the fourth antennal segments, the body beneath, ferruginous; third antennal segment, and the legs, fulvescent. Eyes ruby. Length 3·5 mm., breadth 1·75 mm.

Holotype.—Maleny, Queensland, January (H. Hacker). *He. 3273.*

Paratypes.—Mount Tambourine, Queensland (A. M. Lea). *No. 16888.*

Compseuta tropica n. sp.

(Text-figure 1.)

♀. Head unarmed, smooth, with a central longitudinal sulcus extending from the base to near the insertion of the antennæ; antennal segments I and II of equal length, the second somewhat thinner than the first; III slightly curved, and stouter at apex; IV basally thinner than III, stouter and pilose towards middle, as long as the first and second segments conjoined. Pronotum coarsely punctured, tricarinate, the median carina obsolete on the posterior angle; strongly constricted in front, the anterior margin truncate and touching the base of eyes; disc moderately convex; lateral margins narrowly carinate.

Elytra ovate, broadest at the middle; discoidal area large, the outer margin strongly sinuate; the costal area is biareolate at the base and apex of the discoidal area, uniareolate in the middle; the costal membrane has a single row of large sub-quadrate areolæ, becoming wider, with a few double cells, beyond the middle.

Text-figure 1. [*Photo., H. Hacker.*

Head, body beneath, fourth antennal segment except basally, a lævigate transverse fascia at the base of collum, and a narrow lateral border to pronotum, black; collum, carinæ, and the disc of the pronotum ochraceous, the punctures on the disc are darker; the elytra where they cover the abdomen appear blackish; sutural area centrally, tarsi, and reticulations on costal area and membrane about the middle, fuscous; costal membrane basally and on the posterior half, hyaline with light-brown reticulations; antennæ and legs testaceous. Length 3·5 mm., breadth 1·625 mm.

♂. Differs in colour as follows:—Third antennal segment black, light brown at each extremity; collum and pronotum black, the carina and anterior margin narrowly light brown.

Holotype and *Allotype*.—Cairns District, North Queensland (A. M. Lea). *No. 16889.*

Paratypes.—Same data. *He. 3274.*

The study of this species, which agrees well with the generic diagnosis, shows that the two species *ampliatus* and *secundus*, which were previously placed in *Compseuta*,[4] do not belong to that genus. They differ in possessing a pronotal vesicle, and slender antennal segment IV. Their delicate lacy appearance is quite different from the stout semi-opaque insect described above. In general appearance they resemble *Gargaphia*, but their rostral groove is not interrupted by a transverse carina. Their affinities seem to be nearer *Gelchossa* as amplified by Champion, but in all probability a new genus will be required for these forms.

SUBFAMILY SERENTHIINÆ.

Epimixia alitophrosyne Kirk.

Habitat.—Mount Lofty Ranges, South Australia (N. B. Tindale). Sydney, N. S. Wales (A. M. Lea).

Epimixia vittata Horv.

Habitat.—Launceston, Tasmania (F. M. Littler). Hobart, Tasmania (A. M. Lea). Liverpool, National Park, Mittagong, Sydney, N. S. Wales (A. M. Lea). Cairns District, Bluff, Queensland (A. M. Lea). Adelaide, South Australia (R. J. Burton and N. B. Tindale).

Although ranging from Tasmania to North Queensland, and variable in size and colour, I believe all the above series to be the same species. In many the antennæ and legs are black, and the Cairns series are rather smaller, with a darker pronotal disc.

Nethersia maculosa Horv.

Habitat.—Ooldea, South Australia; Longreach, Queensland (A. M. Lea).

The series before me corresponds well with all the characters given in Horvath's description. The fresher specimens have short hairs on the pronotum and elytra, also erect setose hairs on the femora and tibiæ; in a few specimens, however, they are nearly obliterated. As these characters were not mentioned in the description, it is possible that the type was in an abraded condition.

Nethersia setosus (Hacker).

Ischnotingis setosus Hacker, Mem. Queensl. Mus. ix, p. 23, 1927, pl. vi. fig. 3.

[4] Mem. Queensl. Mus. ix., pt. 1, p. 26, 27 (1927).

Family PIESMATIDÆ.

Mcateella interioris n. sp.

(Plate XXIII, Figure 16.)

Head wide; eyes prominent and coarsely granulated; antennæ set in a large concavity between the jugæ and antenniferous tubercles; segment I greatly swollen, very small at the base; II slightly swollen, about equal in length to the first; III slender, not quite as long as the first and second conjoined; IV swollen towards the apex, fusiform, slightly longer than the third. Pronotum broad, transversely swollen behind the middle, coarsely punctate; paranota cellular, moderately wide, angular in front, narrowing and disappearing behind. Elytra ovate, a little longer than the abdomen, closely covered with small uniform areolæ; sides gently rounded; the carinæ weakly developed, but distinct; legs rather short and stout.

Head pale reddish brown; pronotum pale ochraceous with a brownish suffusion on each side towards the base; anteapical fovæ reddish; scutellum reddish black; clavus pale ochraceous; elytra whitish with a brown trans verse fascia covering the posterior half of the discoidal areas; lateral margins with a row of small brown spots; antennæ, legs, and the body beneath, brownish ochraceous; rostrum fuscous. Length 2·5 mm., width 1·125 mm.

Holotype.—Parachila, Flinders Range (E. L. Savage). *No. 16890.*

Paratypes.—Oldea; Tarcoola, South Australia (A. M. Lea). South Australia (Feuerheerdt). *He. 3275.*

Similar in shape to *M. splendida* Drake but differently coloured. The markings in this species are variable. In some examples, the elytral fascia is well defined at the sides, becoming obsolete towards the centre; in others the fascia is paler, and the whitish ground colour dotted with minute brown specks and reticulations.

EXPLANATION OF PLATES.

All the figures are enlarged sixteen diameters.

PLATE XX.

Fig. 1.—*Cantacader armatus* n. sp.

Fig. 2.—*Cantacader dentatus* n. sp.

Fig. 3.—*Cantacader lcai* n. sp.

Fig. 4.—*Phatnoma pacifica* Kirk.

PLATE XXI.

Fig. 5.—*Phatnoma tindalei* n. sp.

Fig. 6.—*Oncophysa vesiculata* var. *nigra* n. var.

Fig. 7.—*Oncophysa vesiculata* var. *gracilis* n. var.

Fig. 8.—*Oncophysa rufescens* n. sp.

PLATE XXII.

Figs. 9, 10.—*Diplocysta globuliformis* n. sp.

Figs. 11, 12.—*Neopachycysta subopaca* n.g et sp.

PLATE XXIII.

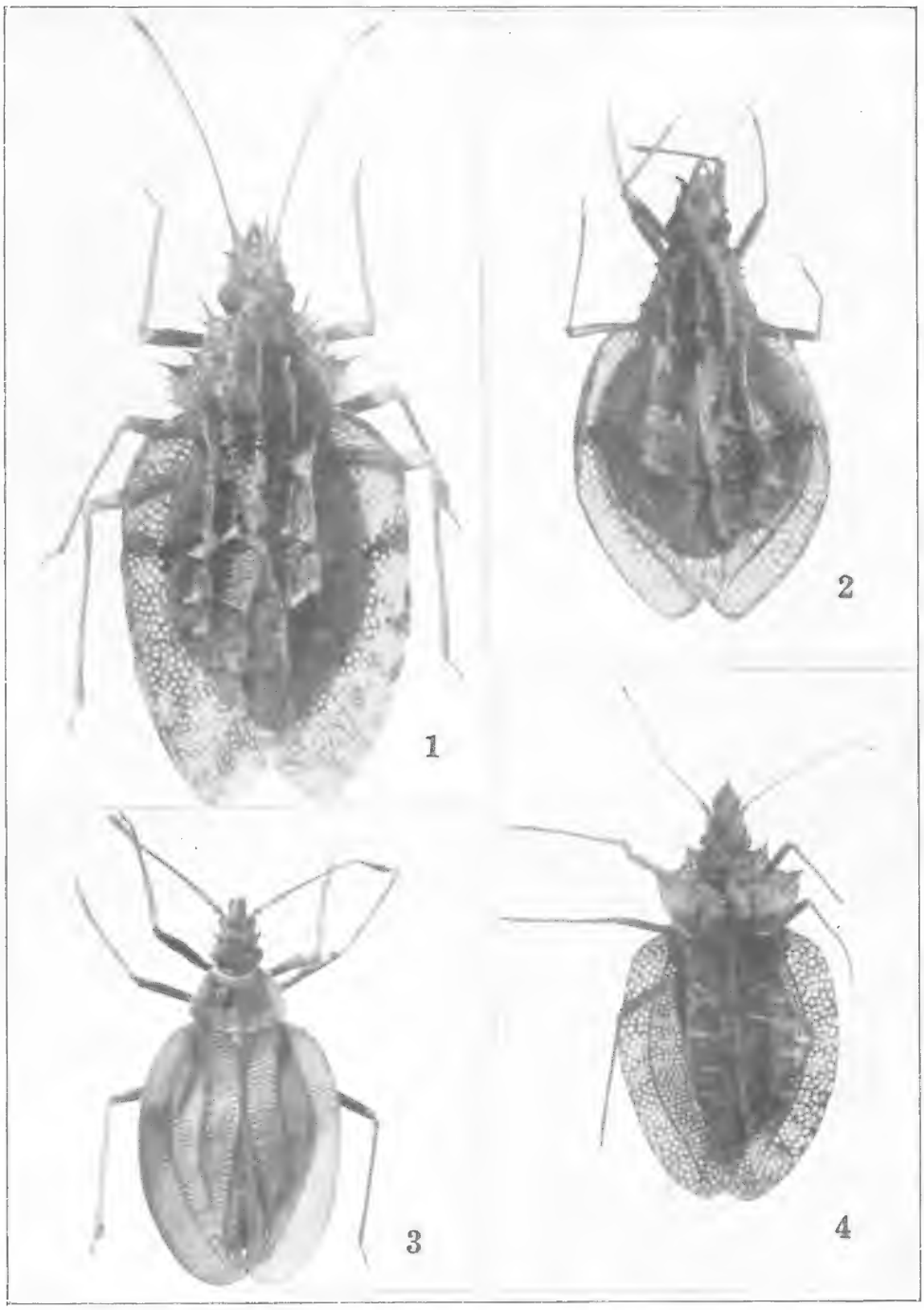
Fig. 13.—*Cystcochila brunnea* n. sp.

Fig. 14.—*Gymnotingis serrulata* n.g. et sp.

Fig. 15.—*Myrmecotingis leai* n.g. et sp.

Fig. 16.—*Mcateella interioris* n. sp.

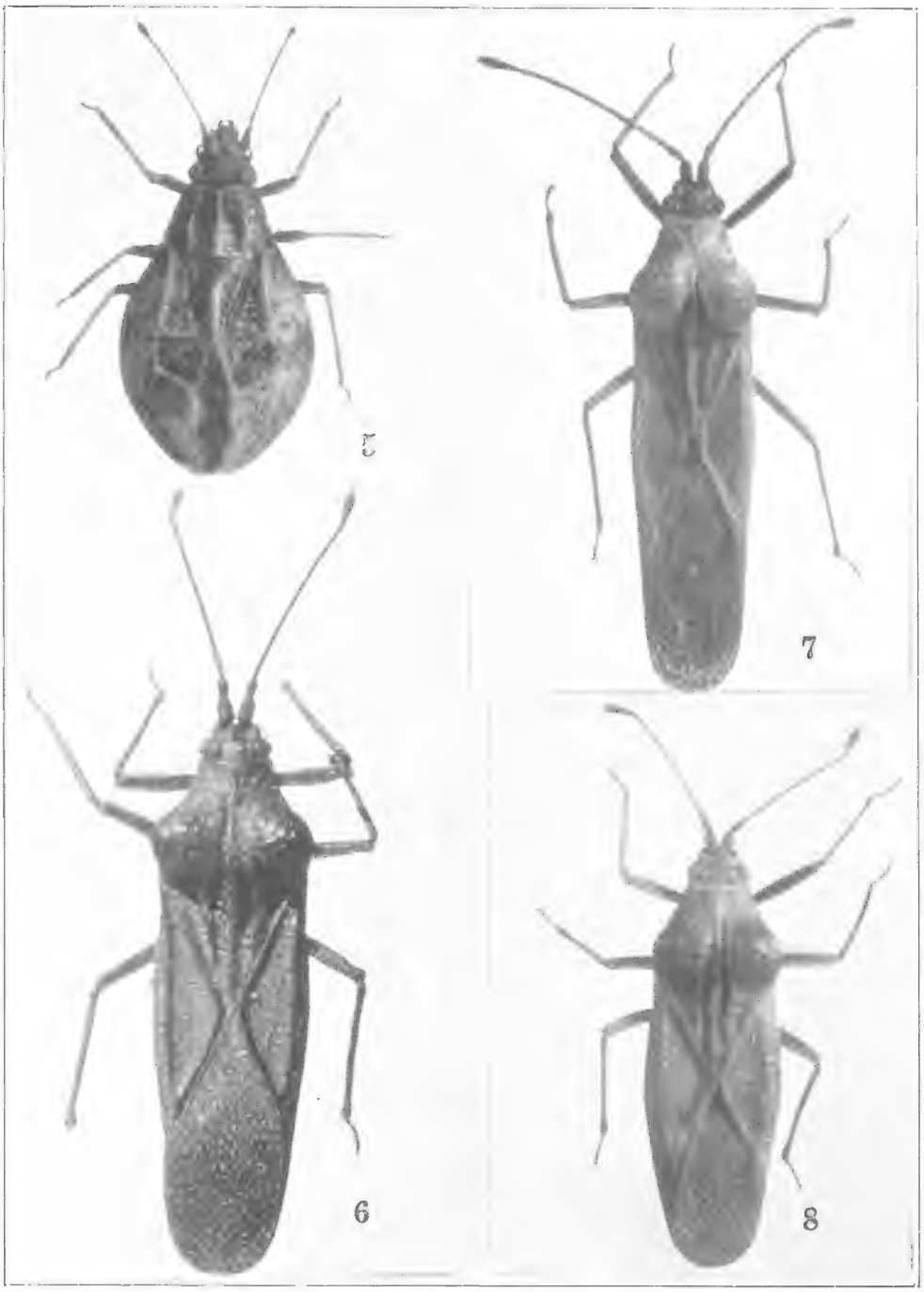
Owing to Figure 16 being strongly lit from the front to show details of head and antennæ, the posterior part appears darker than it is; the elytra beyond the transverse fascia are really as light in colour as they are basally.



Australian Tingitidæ.

Photos., H. Hacker.

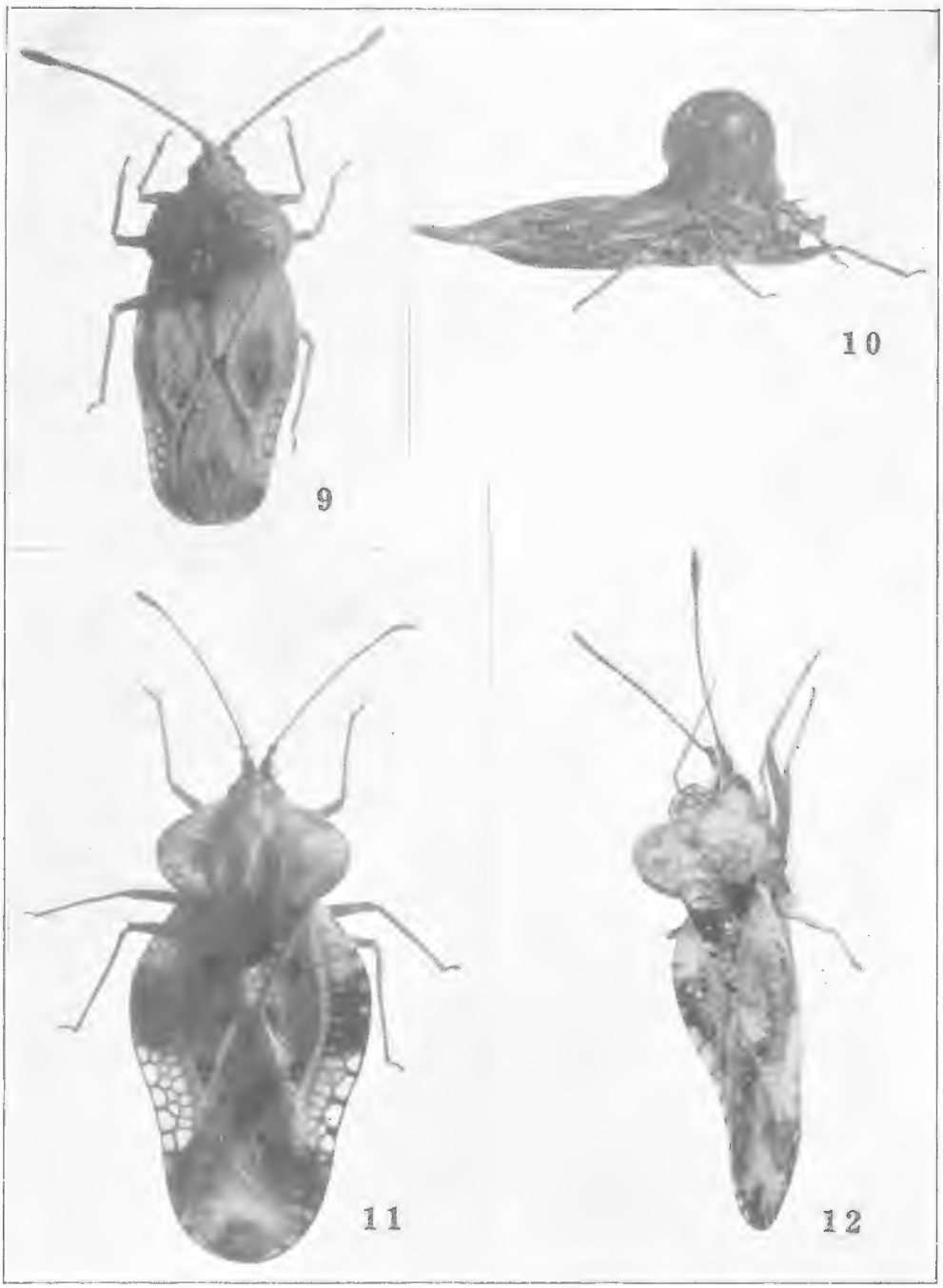
Face page 188.



Australian Tingitidæ.

Photos., H. Hacker.

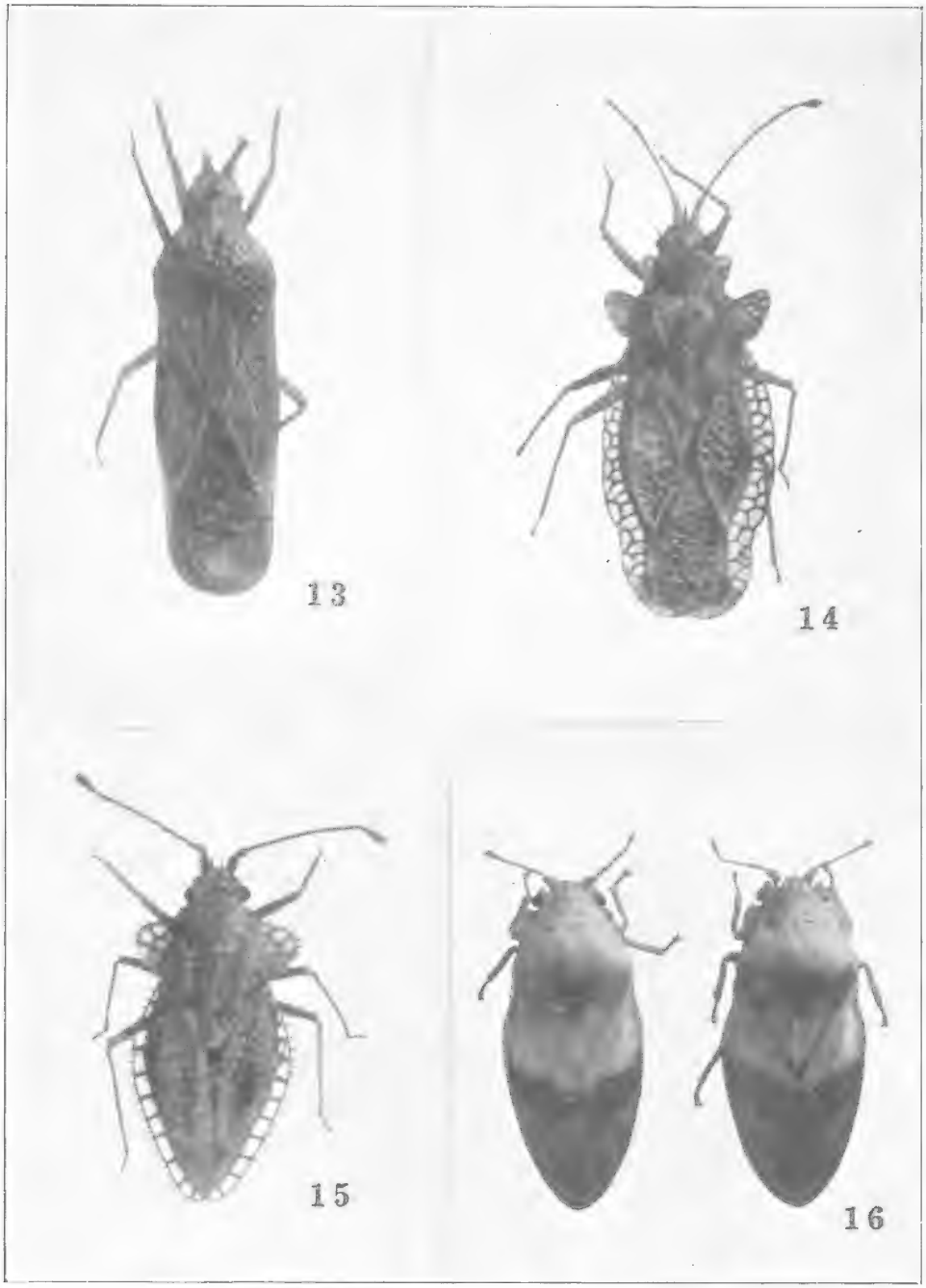
Face page 188.



Australian Tingitidæ.

Photos., H. Hacker.

Face page 188.



Australian Tingitidæ.

Photos., H. Hacker.

Face page 188.

ICHTHYOLOGICAL NOTES, No. 3.

By T. C. Marshall.

(Plate XXIV.)

Family GALAXIIDÆ.

Galaxias attenuatus (Jenyns).

1842. *Mesites attenuatus*, Jenyns, Zool. Beagle, vol. iv, Fish, p. 121, pl. 22, fig. 5.

1905. *Galaxias attenuatus*, Regan, Proc. Zool. Soc. Lond., p. 368, pl. 12, fig. 1, pl. 13, fig. 2.

Mr. R. W. Pearce presented two live specimens of this fish to the Museum. They were taken by him in a small freshwater pool at the Eight-mile Plains, Brisbane. One specimen (which died shortly afterwards) measured 97 mm. in total length. The other, which is of about the same length, is still alive in the Museum aquarium. Mr. W. Willes, of Russell Island, Moreton Bay, forwarded another example (97 mm.), taken by him from a pumping plant in his freshwater dam on Russell Island. Since receiving the above specimens, I have been informed that various members of the Queensland Aquarium Society have met with this species on several occasions, both on the islands of Moreton Bay and also on the mainland. (Qld. Mus. Nos. *I. 4380*, *I. 4382*.)

Family ANGUILLIDÆ.

Anguilla reinhardtii Steindachner.

1867. *Anguilla reinhardtii* Steindachner, Sitzb. Akad. Wiss., Wien., lv, 1, p. 15, figs. *a* & *b*.

On the 11th February last, Mr. Jack Campbell presented an elver of this species to the Museum. It was collected in a hand-net, together with several *Melanotænia nigrans*, in a small stream near Aspley, Brisbane. The interesting feature of this specimen is its smallness, being only 54 mm. in total length and 5 mm. in depth of body. (Qld. Mus. No. *I. 4434*.)

Family LATILIDÆ.

Branchiostegus[1] sp.

1815. *Branchiostegus*, Rafinesque, Analyse de la Nature, Palermo.

1830. *Latilus*, Cuvier & Valenciennes, Hist. Nat. des Poiss., vol. v., p. 368.

1902. *Latilus*, Jordan & Snyder, Proc. U.S. Nat. Mus. 1902, vol. 24, p. 488.

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[1] As noted by Jordan & Evermann (The Genera of Fishes, 1917, p. 90), Rafinesque's genus *Branchiostegus*, published in 1815 as a substitute for *Coryphænoides*, Lacépède 1802 (not of Gunner, 1761), has precedence over *Latilus* of Cuvier & Valenciennes, 1830.

A specimen 455 mm. in total length was caught 40 miles off Noosa Heads, South Queensland, by Mr. Laurie Rhodes, who kindly presented it to the Museum. (Qld. Mus. No. *I. 4389.*) On examination this proved to be a species of *Branchiostegus*, a genus not hitherto recorded from Australian waters.

This specimen does not agree with the descriptions of "Latilus" published in literature available here. Unfortunately, I am unable to consult Kishinouye's paper on the Japanese species, containing the description of his "*L. auratus.*"[2] In the circumstances I am compelled to content myself with recording the specimen generically for Australia.

Family CARANGIDÆ.

Elagatis bipinnulatus (Quoy & Gaimard).

(Plate XXIV, Figure 1.)

1824. *Seriola bipinnulata* Quoy & Gaimard, Voy. Uranie, Zool., vol. i, p. 363, pl. 61, fig. 3 (Keeling Islands).

1896. *Elagatis bipinnulatus* Jordan & Evermann, Bull. 47 U. S. Nat. Mus. (1), p. 906.

1907. *Elagatis bipinnulatus* Stead, Add. Fish Faun. N. S. Wales.

A fine example, measuring 980 mm. in total length, was captured at Flat Rock, South Queensland, and presented by Mr. F. Leach. (Qld. Mus. No. *I. 4378.*)

This is the second record of this species from Australian waters, and a new record for Queensland. The first specimen was collected off Port Jackson, New South Wales, in 1907.[3]

Family LOBOTIDÆ.

Lobotes surinamensis (Bloch).

1790. *Holocentrus surinamensis* Bloch, Aust. Fische, vol. iv., p. 98, pl. 243..

1876. *Lobotes surinamensis* Bleeker, Atlas Ichth., vol. viii, p. 12, pl. 311, fig. 4 (as *L. erate* C. & V.).

1881. *Lobotes auctorum* Gunther, var. *somnolentus* C. & V. Macleay, Proc. Linn. Soc. N. S. Wales, vol. 5, p. 375.

A well-marked fish measuring 355 mm. in total length was caught off Luggage Point, Moreton Bay, and presented by Inspector W. Hiddens. (Q.M. No. *I. 4391.*)

Family CORIDÆ.

Coris aygula Lacépède.

1802. *Coris aygula* Lacépède, iii, p. 96, pl. 4, fig. 1.

1878. *Coris aygula* Day. Fishes of India, p. 408, pl. lxxxviii., fig. 5.

1915. *Coris aygula* Ogilby. Commerc. Fishes and Fisheries of Qld., p. 33. (An Essay.)

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[2] Kishinouye, Zool. Mag., xix, Feb. 15, 1907, p. 59.

[3] Stead, Add. Fish. Faun. N. S. Wales, 1907, p. 17, pl. 5.

In December last a large head of what is apparently *Coris aygula* was received from Bowen, North Queensland, through the kindness of Mr. E. H. Rainford.

This head has the very prominent bump on the nape, similar to an "Old Man Snapper." Its colour is now "terre verte," but when first received was dark blue. It is finely vermiculated over all its surface (with the exception of the lips) with short, wavy, bluish white crescentic lines and spots.

There does not appear to be a posterior canine present.

Ogilby[4] described the life colours of this variable Labrid from a series of five specimens from Lord Howe Island, measuring from two and one-third inches to twenty-eight inches in length.

Assuming the length of the head to be somewhere in the proportion of three and three-quarters or four in the total length, our specimen must have belonged to a fish forty-five to forty-eight inches in length, surely a record for the species.

Coris picta (Bloch & Schneider).

(Plate XXIV, Figure 2.)

1801. *Labrus pictus* Bloch & Schneider, Syst. Ichth. 1801, p. 251, pl. 55.

1903. *Coris picta* Waite, Rec. Aust. Mus., vol. 5, 1903, p. 26, pl. 5, fig. i.

Two well-marked specimens of this handsome "Comb-fish," 223 mm. and 265 mm. respectively, were recently presented to the Museum by Mr. Cecil Anderson and Inspector W. Hiddens, of the State Fisheries Department. The former was taken at Point Lookout, Stradbroke Island, and the latter specimen off Cape Moreton, South Queensland (Qld. Mus. Nos. *I. 4433*, *I. 4431*).

Thalassoma lunaris (Linnæus).

1758. *Labrus lunaris* Linnæus, Syst. Nat., 10th ed. 1758, p. 283.

1862. *Julis lunaris* Bleeker, Atlas Ichth. i, 1862, p. 90, pl. 33, 5.

1893. *Thalassoma lunare* Kent. "The Great Barrier Reef," p. 296, pl. xvi, fig. 13.

A beautiful example of this somewhat rare Labrid, caught by Mr. S. Leach off Cape Moreton, South Queensland, was forwarded to the Museum by my friend Inspector W. Hiddens, of the State Fish Supply. It measured 300 mm. long (caudal lobes included). (Q. M. No. *I. 4430*.)

The only other previous records for Queensland of this beautiful species are Saville-Kent's[5] specimen from Rocky Island, Cape Flattery, and three old specimens in our collection registered from Moreton Bay.

I take the opportunity here of thanking Inspector W. Hiddens for his many donations of fishes, almost all of which have proved to be rare or little-known species.

[4] Mem. Aust. Mus., No. 2, 1889, p. 68.

[5] The Great Barrier Reef, by W. Saville-Kent, 1893, p. 296, pl. xvi, fig. 13.

Owing to the absence of a good description of the appearance in life of this fish, and also its many apparent variations, I shall here describe the colours of our specimen, taken a short interval after death. The colours are those of Ridgway's "Nomenclature of Colors."

General body colour "terre verte," strongest in a vertical band about one inch in width, extending from a point below the first six dorsal spines to midway between the ventral and anal fins, where it widens and is lost in the surrounding body colours posteriorly. Against the salmon colour of the belly it is somewhat sharply defined. Each scale, observed separately, is "parrot green," edged with "apple green," and with a narrow, vertical, central bar of pale rose madder.

The head is "saturn red" marked with a series of green bands. The "saturn red" is strongest on the nape, gradually softening towards the ventral surface and fading into salmon on the belly. The first or superior band, which is "apple green" in colour, extends from the premaxilla to a point a little over halfway to the first dorsal spine. It is much wider than the succeeding bands, being at its greatest width equal to the diameter of the eye. The second band, which is joined anteriorly to the first slightly before the eye, runs partly through and across the top of the ocular region and is lost in the surrounding colour midway between the operculum and the dorsal surface. The third, a short postorbital band, commences on the posterior edge of the orbit and extends along the upper edge of the operculum. The fourth, commencing at the gape of the mouth, extends upwards and across the lower edge of the eye, thence downwards to the posterior border of the operculum, and on a line horizontally with the base of the pectoral. The fifth and sixth are joined anteriorly at a point slightly below the gape and terminate on the edge of the sub-operculum. The lateral bands are all sub-equal in width and are in colour "Paris green" with flushes of "beryl green."

The inferior band commences as a diamond-shaped "campanula blue" patch on the throat, which narrows and changes to "Paris green" as it extends, fairly well defined, down to the isthmus. It continues to the base of the ventrals, though faintly.

The eye is "Paris green," with the black pupil surrounded by a narrow gold ring. A horizontal "Paris green" band, swollen at its anterior extremity, extends between the pectorals and ventrals, and is in length as long as the latter.

The dorsal and anal fins are "saturn red" along their basal portion, slightly crenulated and sharply defined from the neighbouring colour by a very narrow, dusky black line. Outer portion of the dorsal and anal fin "Paris green" with shades of "apple green." A very small black smear appears between the second and third dorsal spines.

Caudal with a large "lemon yellow" spot, fading outwards to "Paris green" anteriorly and creamy white posteriorly. This spot is bordered on

Fig. 1.—*Elagatis bipinnulatus* (Quoy and Gaimard). From cast in Queensland Museum.

Fig. 2.—*Coris picta* (Bloch and Schneider). From cast in Queensland Museum.

both dorsal and ventral surfaces by a bar of "saturn red," which in its turn is bordered by a narrow "beryl green" edge, both of which terminate at the extreme tip of the caudal lobes.

The pectorals are "lemon yellow" and the posterior margin is sharply demarcated with a beautiful broad "hyacinth blue" border; antero-superiorly, there is a small black axillary spot. (Qld. Mus. Reg. No. *I. 4430.*)

Ophthalmolepis lineolatus (Cuv. & Val.).

1839. *Julis lineolatus* Cuvier & Valenciennes. Hist. Nat. Poissons, xiii, p. 436.
1865. *Ophthalmolepis lineolatus* Kner. Novara Zool., vol. i, Fische, p. 258, pl. ii, fig. i.

Through the kindness of Mr. George Hissted, a specimen of this beautiful Labrid was presented to the Museum. It was captured off Caloundra, South Queensland, and measured 258 mm. in total length. Although common in New South Wales, this species appears to be rare in Queensland, the above example being a new record for our State. (Qld. Mus. No. *I. 4376.*)

Family LIMNICHTHYIDÆ.

Schizochirus insolens Waite.

1904. *Schizochirus insolens* Waite, Rec. Aust. Mus., vol. v, pt. 4, p. 242, pl. 26, fig. 3.

Three specimens of this rare species, of which previously only two were known,[6] were forwarded to the Museum by one of our old and esteemed honorary collectors, Mr. James Palmer, of Cowan Cowan, Moreton Island, Moreton Bay. They measure 46, 51, and 57 mm. respectively, and were taken by him at Cowan Cowan. This makes another new record to be added to the list of Queensland Fishes.

[6] Waite, Rec. Aust. Mus., vol. v, pt. 4, p. 242, pl. 26, fig. 3.

BIRDS AND DROUGHT IN CENTRAL-WESTERN QUEENSLAND.

By F. L. Berney.

The disastrous drought that has gripped Western-Central and Western-Northern Queensland during the past few years must have very seriously affected local bird life, not alone by actual deaths, but also by the absence of increase of broods. To emus the result has been tragic, and they have been totally exterminated on many holdings. Previously one would be certain of seeing them in the course of any day's ride on Barcarolle. On occasions I have had as many as seventeen or eighteen grown birds in sight at once, and each winter, if there was sufficient rain, two or three broods would be reared. To-day not a solitary individual survives here. The fencing of the country, especially the tall dog-netting fences—for they could get over the ordinary six-wire fence—has spelt ruination to these interesting birds, for as paddocks went dry the stock would be moved elsewhere but the emus remained to perish. Much as this was deplored, there was no help for it, but I am glad to say that none perished of thirst on this place.

From the middle of February 1925 *to the latter part of June* 1926, *a matter of nearly seventeen months, I saw absolutely no evidence of any bird nesting.* Even the Corvidæ, birds that one would think would rather revel in hard times with so many dead animals about, were not nesting, but that is perhaps to their credit, indicating that they require not carrion but a variety of insects on which to rear their nestlings.

As the result of two inches of rain in May 1926, the period from 25th June that year to July 1927 showed a slight improvement, but still very few birds have nested, very few indeed. As a matter of fact my records extend to seven species only, perhaps a dozen nests all told, and in four of these that I was able to keep under observation the owners had restricted themselves to very small broods, as follows:—

Galah, *Kakatoe roseicapilla* (average clutch four to five eggs), two eggs only; Yellow-throated Miner, *Myzantha flavigula* (clutch three to five eggs), two eggs only; Yellow Weebill, *Smicrornis flavescens* (clutch two to three eggs), one egg only; Black-backed Magpie, *Gymnorhina tibicen* (clutch three to five), two eggs only. The remaining birds noted nesting were Crested Pigeon, *Ocyphaps lophotes;* Yellow-tailed Tit, *Acanthiza chrysorrhoa,* and one of the *Artami.*

During the period from July 1927 to date, 21st February, 1928, drought conditions have continued and very few birds have nested. Perhaps the most striking evidence of the dryness of the season is the fact that I have not, during that period, seen a single instance of nesting among such very hardy and common birds as Galahs, *K. roseicapilla,* Black-backed Magpies, *G. tibicen,* and Crested Pigeon, *O. lophotes.*

It is impossible to overlook the first-named when nesting, for the unceasing wheezing crying of the young birds fills the air from daylight to dark and is very trying. As it is I have not heard a sound from a youngster this spring or summer. A pair of Galahs that always have made use of a hollow bloodwood tree right against the homestead buildings for nesting purposes have nested once only during the past three seasons. They have been about all the time, and once in anticipation of rain relined the nest with green eucalypt leaves, but the rain failing they did no more. I am satisfied that it is the same pair that have occupied this tree for very many years.

I believe some of these nesting sites in old hollow trees have, like ancestral homes in the old country, been in the possession of the same family of Galahs for many generations, perhaps hundreds of years; when one of the pair died the other found a mate from among unattached birds, but the old home would never be deserted.

During the past three years our total rainfall has been 17½ inches, when we should have had, according to the average of nearly forty years, about 4 feet. Under the circumstances, insects, particularly caterpillars and grasshoppers, have been very scarce, and the same applies to seeds and berries.

The crop of fruit on small berry-bearers such as *Carissa lanceolata* and the Mistletoes (*Loranthi*) has been a failure for a couple of seasons, many bunches of the latter having died.

THE FLOCK PIGEON: *HISTRIOPHAPS HISTRIONICA.*

By F. L. Berney.

Among ornithologists the fate of this pigeon has been a matter of concern for some years. As long ago as 1916 I was asked what had become of it. During the war years I was unable to give the matter any attention, but since the end of 1919 I have been always on the watch for it, and also seeking information from others.

The species is poorly represented in Australian collections, public or private, for in all our National State Museums I do not think there are a dozen skins.

My personal experience of the Flock Pigeon in Queensland is as follows:— In 1886 a series of dry years broke up on the Barcoo with rain in May, after which there was a wonderful crop of herbage, crowfoot, and wild carrot, such an abundance as had not been known since the country had been occupied by white settlers. Flock Pigeons, of which up to then I had seen nothing, came in thousands to Northampton Downs, and later nested everywhere on the open country, their two eggs being placed without any constructed nest under the shelter of tussocks of grass or herbage. They showed no inclination to congregate in this matter; their nests were thoroughly scattered, but, owing to the great number of individuals in the district, sitting birds kept bustling out with a rattle of wings from their nest-sites every few yards as one rode across country. They remained long enough for their youngsters to get strong on the wing and then left the neighbourhood entirely. I have no recorded dates, but I think they nested during July and August, and had all cleared out by the end of October. In subsequent years I saw but very little of them there, and then at irregular times. It was not till 1898 that I kept careful data of their coming and going, and in January that year I noted eight or ten together on Cameron Downs, on the Landsborough, having not previously come across them for some years. It was two years before I saw them again, and then it was February and near Richmond on the Flinders, N.Q., where during the early part of 1900 I flushed a few small lots, a couple of hundred being the most I found together. After March that year they disappeared till August 1901, when I saw them in flocks, which in my diary I have described as "immense," on Manfred Downs farther down the Flinders, but in nothing like the numbers I had experienced on the Barcoo in 1886.

Subsequently they disappeared again for eighteen months till January 1903, and from that date to September 1908 I have records of them every year on the Flinders below Richmond, but always they were in small numbers. 1906 was the best of these years; I found ten nests with eggs and five others were reported to me. They left the neighbourhood in September and October, none being seen after the middle of November.

In February 1907 two or three small lots showed up but left again almost at once. There were a few through the winter of 1908, but only a few, and they left during October. In 1909 none were recorded, but during February 1910 a few pairs nested with us and I found three nests with eggs. 1911 and 1912 were absolutely blank, and on the 14th September 1913 I flushed a single bird at Sylvania, 20 miles west of Hughenden, and this, so far as my own personal experience goes, is my last record. Judging by my notes they appear to have avoided Central-Western Queensland entirely during the months of December and January, and were seen only once or twice in November and February. Discussing the matter with a bushman friend, Mr. Chas. Wray, of Stonehenge, Queensland, with a longer Western record than mine, he said he remembered these pigeons in 1886 at Bimerah on the Thomson, and in similar great numbers in 1882 further west on the Georgina, but whereas in 1886 they were in thousands, in 1882 they were in tens of thousands.

Dr. MacGillivray, of Broken Hill, who has had personal experience of these pigeons in the far North years ago, but now fears that their days are numbers:—Gould in 1839, Sturt in 1844, Leichhardt in 1847, H. K. Bennett Darling in the early 'sixties' and used to describe flocks that rose from the grass on the river country as being over 2 miles in length. They are unknown throughout this country now." Such a flock as this may seem incredible to any but those who have seen this pigeon in uncountable thousands.

1901 appears to be the last date on which Flock Pigeons were seen in great numbers; Mr. Tom Carter then reported them in "countless myriads" in Western Australia, and this coincides with my own experience. Previous to that year there were fairly constant records of the birds appearing in immense numbers:—Gould in 1839, Sturt in 1844, Leichhardt in 1847, H. K. Bennett in 1864, W. L. Thornton in 1866, Price Fletcher in 1878, Chas. Wray in 1882, myself in 1886, and the Calvert Expedition in 1898. These records are from localities as far apart as west of Western Australia, North Queensland, and south-west of New South Wales.

I have searched "The Emu" for any recent mention of the species, and the only reference therein is one by the late Mr. Dudley Le Souef, who records that he saw a few in 1919 coming in to water near Prairie, 27 miles east of Hughenden.

In reply to my inquiries Messrs. H. A. Barnard and Lawson Whitlock very kindly gave me their experiences of the Flock Pigeon. Mr. Whitlock wrote that in 1908 on the de Grey, W.A., about 20 miles from its mouth, he shot one as it came in alone to water; one or two more came to drink during the day but were not interfered with. Mr. Barnard writes that in February 1913, when about 25 miles west of Brunette Downs in the Territory, he flushed three separate pigeons some miles apart; again in May of the same year at Boroloola on the McArthur a small flock of five were seen, and in June the same year a further small flock of eighteen were noted halfway between Anthony Lagoon and Brunette. Both writers mention that they never met with the species before or since.

I had great hopes that these two ornithologists would be able to give evidence that the Flock Pigeon might still be found in some numbers "farther out," and such meagre information was disappointing.

Mr. J. Sutton has been good enough to look up and copy out for me what entries there are referring to this bird in the "South Australian Ornithologist." They are all sent in by Mr. L. Reese, of Minnie Downs Station, in the north-east corner of South Australia, and are as follows:—15th March, 1924—"Flock Pigeons occasionally come, the largest flock was about eight birds." October 1926—"I noticed three small flocks, 7, 5, and 3." February 1927—"At Lake Goyder, on Coongy Station, I saw about thirty Flock Pigeons." Later, in July, he noted with regret that the pigeons had all gone.

After 1901 the number of the Flock Pigeon fell in a manner that is nothing less than tragic. It would be quite possible for a small bird frequenting forest or scrub to avoid observation for some time, but a conspicuous pigeon such as this, living on open country and drinking always at the barest and most exposed watering-places it can find, could hardly be overlooked.

Stocking the country with cattle and sheep must have interfered with such a ground dweller, but it should have been little more than inconvenience to a vigorous bird of this sort, strong on the wing, for just beyond the tide mark of occupancy by whites there must be hundreds, many hundreds of miles of country suitable for Flock Pigeons. The few, the comparatively few, that have been shot for the pot have, I feel convinced, had nothing to do with their extinction. Then, too, with the advance of civilisation has come the disappearance of the aboriginals, who must collectively have destroyed far more than the whites, for, besides those they killed when the birds came to water, every egg and squab that could be found, we may be sure, was eaten by the natives.

The disappearance of this pigeon is not a parallel case with the Passenger Pigeon of America, for the latter had the fatal habit of nesting in immense, densely inhabited colonies, at times as many as a hundred nests, we read, being in one tree. To these rookeries gathered every predatory bird and carnivorous animal from miles and miles around; the settlers, too, with their families from far and near joined the animals, and while the nesting season lasted ruthlessly destroyed much more than they made use of.

The Flock Pigeon, making no conspicuous nest, scattered about on open downs, never had to face carnage such as this. To anyone familiar with these birds a few years back in their thousands, their disappearance is a sad mystery, one of those seemingly wanton acts of Nature for which there appears no sufficient reason.

Keulemans in Mathew's work gives a good plate of this pigeon, but he shows the birds—a pair—as sitting on branches, low ones it is true, but this I think is incorrect; I never saw them settle on anything but the ground. Their colouration, to which seems to be specially added the exceptionally long sandy-brown upper tail coverts to cover the otherwise rather conspicuous grey black and white tail feathers, must be a wonderful protection to them against either

diurnal or nocturnal birds of prey and animals. At night they always, so far as I can see by their tracks (very slight depressions in the loose soil with a deposit of excreta alongside), roost on the barest patches of ground.

Winter and spring would appear to be their nesting season in West-Central Queensland; in 1886 they nested in great numbers during July and August; in 1904 I have one record only, and that mid-September; in 1906 I saw nests with eggs in every month between April and September, inclusive; in 1908 I have again only one record of eggs, and that was in August, but in 1910 I have three nests with eggs during first half of February.

The Director of the Perth Museum, in reply to my inquiry, writes that the Flock Pigeon is to be found in Western Australia, but seems to be limited to the Kimberley district in the extreme north.

I was closing these notes in a pessimistic vein when two letters were kindly forwarded by Mr. J. M. Devaney, who contributes "Nature Notes" to the "North Queensland Register." Both are written about the same date—February 1928—and from practically the same district—the Flinders River basin, N.Q. I know the part well and the birds thereto belonging, and although I think neither of the writers would claim to be ornithologists, still I am quite satisfied that they are correct in their identification of the species when they both report seeing the Flock Pigeon about in flocks up to four or five hundred at the time of writing. This makes matters rather more hopeful, but flocks of the size mentioned are a long way short of the many thousands in which they used to be seen.

A well-known bird observer, Mr. D. W. Gaukrodger, writes in Mr. J. O'Neil Brenan's "Nature Notes" in the Brisbane "Daily Mail" (31st March, 1928) that he hears from authentic sources that the Flock Pigeon "is back again at its old haunts on the Barcoo and Warrego watersheds, and it is reported from Mount Inniskillen, in the Tambo district, as having at last reappeared and nesting freely. Also I have reports from Duneira, near Blackall, and Burenda, in the Augathella district, of their reappearance."

Still later (2nd April), Mr. D. Macartney, Longreach, informs me that the Flock Pigeon are "in big numbers between here and Arrillalah. . . . Perhaps they have been driven in by the severe drought in the centre of Australia."

This information is gratifying, but there is no escape from the fact, however, that there has been a woeful decrease among these birds in the last five-and-twenty years. But as to whether this decrease will continue it is impossible to say, for we have no idea of the cause. Considering the way this bird moves about and the immense flocks in which it gathers, it is inconceivable that great numbers can be anywhere in hiding, so to speak, in Australia.

North records that this handsome pigeon has bred in captivity, and it is to be hoped that further attempts will be made in this direction.

ADDITIONS TO THE CRETACEOUS AMMONITE FAUNA OF EASTERN AUSTRALIA.

PART 2 (DESMOCERATIDAE).*

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(Plates XXV–XXVI.)

Family DESMOCERATIDÆ Zittel.

In the Cretaceous beds of Eastern Australia this family is known only from the Tambo Series of Upper Albian age. *Desmoceras* itself may be present in these beds. Two other genera of world-wide distribution (*Puzosia* and *Beudanticeras*) are known, while two new genera (*Boliteceras* and *Cophinoceras*) are now described from this area.

The investigation of these forms is rendered rather difficult by the approximation of *Beudanticeras ingente* to *Desmoceras* on the one hand and to *Puzosia longmani* on the other.

This raises the question whether the Australian desmoceratids as a group may not represent an offshoot from *Desmoceras* distinct from the European lineage.

Genus DESMOCERAS Zittel (emend Grossouvre).

DESMOCERAS (?) SP.

(Plate XXVI, figures 1 *a*, *b*.)

The present figured specimen may represent an unusually compressed species of *Desmoceras*. It is, however, possible that this form may be merely the young stage of *Beudanticeras ingente* which, as mentioned below, closely approaches *Desmoceras* in inflation and shell type. Until the earlier stages of that species are known with certainty it is inadvisable to attach any definite specific name to this form.

Locality.—Hughenden (M.M. Coll.).

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* The earlier papers in this series have appeared in the Memoirs of the Queensland Musuem, vol. viii, pt. 3 (1926) and vol. ix, pt. 1 (1927).

Genus PUZOSIA Bayle.

PUZOSIA LONGMANI Whitehouse.

1926 *Puzosia longmani* Whitehouse (13), p. 218, pl. 37, fig. 5; pl. 39, fig. 1.

No further specimens of this form have been found.

Genus BEUDANTICERAS Hitzel.

The Eastern Australian species included in this genus form an interesting suite. *B. mitchelli* and *B. flindersi* are normal forms within the genus. The other two species (*B. sutherlandi* and *B. ingente*) while apparently related to *B. mitchelli* are rather unusual, *B. sutherlandi* being remarkably involute and *B. ingente* unusually inflated.

BEUDANTICERAS MITCHELLI (Etheridge).

(Plate XXV, figure 2.)

1872 *Ammonites beudanti* var. *mitchelli* Etheridge (1) p. 345, pl. 23, fig. 1.

Remarks.—In a previous paper (13, p. 219) the writer followed R. Etheridge Jr. in regarding *Ammonites beudanti* var. *mitchelli* Etheridge as a synonym of *Ammonites flindersi* McCoy. At that time McCoy's type specimen had not been figured and the holotype of neither specimen had been examined by the writer. Since then both specimens have been seen, and it now appears that they represent two distinct species. It is necessary, therefore, to retain Etheridge's specific name.

B. mitchelli differs from *B. flindersi* in the sides being less convergent and the umbilicus more gradate, while the septal suture of the species has more wide-stemmed saddles than those of *B. flindersi*. Among foreign species it appears to be most like *B. sphærotum* (Seeley) (see 12, p. 53, pl. 3, fig. 1), though it is rather less involute. *B. sphærotum* also has periodic swellings, hardly to be called costæ, similar to those which occur on *B. mitchelli*.

The original of Plate 23, fig. 1 in Etheridge's paper (1) is now chosen as lectotype. The other figured specimen has not been traced.

Dimensions.—Lectotype: 128. 49. 27. 27.

Locality.—Hughenden (Q.M. Coll., lectotype).

BEUDANTICERAS FLINDERSI (McCoy).

(Plate XXV, figure 3.)

1865 *Ammonites flindersi* McCoy (8), p. 51.
1865 *Ammonites flindersi* McCoy (9), p. 334.
1867 *Ammonites flindersi* McCoy (10), p. 196.
1868 *Ammonites flindersi* McCoy (11), p. 42.
1892 *Haploceras flindersi* Etheridge Jr. (6), p. 494, pl. 30, figs. 1–3.
1902 *Haploceras flindersi* Etheridge Jr. (4), p. 31.
1926 *Beudanticeras flindersi* Whitehouse (13), p. 219.

Opportunity is taken now to figure McCoy's holotype, of which hitherto no figure has been published.

With the exception of specimens originally described by Etheridge as *Ammonites beudanti* var. *mitchelli*, all the figured specimens from Eastern Australia described as *Ammonites* (or *Haploceras*) *flindersi* belong to this species. It is distinguished from the closely related *B. mitchelli* by the more convergent sides and by the saddles of the septal suture having narrower stems. Its relations have been fully discussed in an earlier paper in this series.

The South Australian fragment referred by Etheridge to *Haploceras daintreei* (3, p. 44, pl. 7, fig. 1) may be a portion of the body chamber belonging to this species, but the specimen is too indefinite for determination. It does not belong to *Parahoplitoides*, as the writer had considered in an earlier paper (13, p. 206).

Dimensions :—Holotype : 150. 46. 25 (+). 26.
88. 48. 27. 28.

BEUDANTICERAS SUTHERLANDI (Etheridge).

(Plate XXV, figure 4.)

1872 *Ammonites sutherlandi* Etheridge (1), p. 345, pl. 21, fig. 4.
1892 *Ammonites* (*Haploceras*) *sutherlandi* Etheridge Jr. (6), p. 496, pl. 29, fig. 4.
1926 *Beudanticeras* (?) *sutherlandi* Whitehouse (13), p. 222.

This species, of which the holotype is now refigured, is an abnormal form of *Beudanticeras* in being so involute. It is, however, of the same group as *B. mitchelli*.

This form appears to be rare in the Tambo Series. The holotype is the only large specimen which definitely can be referred to this species, although several small forms in various collections examined by the writer may represent *B. sutherlandi*.

Dimensions.—Holotype : 70. 53. 23. 21.

Locality.—Marathon (Q.M. Coll., holotype).

BEUDANTICERAS INGENTE sp. nov.

(Plate XXV, figure 1.)

Description.—Coiling oligogyral, subangustumbilicate. Whorls moderately inflated, sides slightly convergent, venter arched. Gradumbilicate. Test smooth, with periodic constrictions. Septal suture complex with deeply incised saddles and lobes, the first lateral lobe being rather unsymmetrically trifid.

Remarks.—The species is remarkable for its inflation, the nearest form in that respect being, apparently, the Indian *B. stoliczkai* (Kossmat) (7, p. 119, pl. 18, fig. 6), which is similar also in lateral view. *B. ingente*, in proportions,

is approaching the type of shell shown by the more involute species of *Puzosia* such as *P. communis* Spath (12, p. 47, pl. 2, fig. 3). This suggests that *Puzosia longmani*, occurring also in the Tambo Series of Queensland, possibly may be a form related to the present species.

The shell has not quite the extreme inflation of *Desmoceras*. The species is thus, morphologically, somewhere on the border line between the genera *Desmoceras*, *Puzosia*, and *Beudanticeras*. From its general resemblance to *B. mitchelli* it is here regarded as belonging most appropriately to *Beudanticeras*, representing a species of that genus with a homeomorphic resemblance to forms in the two other genera mentioned.

Dimensions.—Holotype: 133. 49. 32. 23.

Locality.—Beaconsfield (G.S.Q. Coll.).

Genus BOLITECERAS nov.[1]

Genotype: *Ammonites daintreei* Etheridge.

Definition.—Involute, sub-discoidal shells with peripheral costæ and faint periodic constrictions. Septal suture with rather wide-stemmed saddles and regularly trifid first lateral lobe.

Remarks.—The genus is proposed for the group of *Ammonites daintreei* which, on a previous occasion (p. 221), the writer had included provisionally in *Beudanticeras*, although stating that probably it was distinct from that genus. The recognition that *Ammonites daintreei* is not an isolated species with these features now emphasises the need for the group to receive separate generic recognition.

Boliteceras, as mentioned before (13, p. 221), is very similar to the Aptian *Uhligella* and, like it, develops puzosid ornament. The young stage (at least up to a diameter of 25 mm.), as shown on the holotype of *B. daintreei*, is more inflated than in the adult stage, has only striæ developed on the test, and has a rather sub-circular whorl section. This suggests that *Boliteceras* may have developed more or less directly from *Desmoceras*.

The genus is distinguished from *Beudanticeras* mainly by the ornament of the test.

Age.—Upper Albian.

BOLITECERAS DAINTREEI (Etheridge).

(Plate XXVI, figure 2.)

1872 *Ammonites daintreei* Etheridge (1), p. 346, pl. 24 (in part).
1892 *Haploceras daintreei* Etheridge Jr. (6), p. 495, pl. 29, figs. 1-3 (in part).
1901 *Haploceras daintreei* Etheridge Jr. (2), p. 30, pl. 1, fig. 3.
1902 *Haploceras daintreei* Etheridge Jr. (4), p. 49, pl. 7, fig. 1.
1926 *Beudanticeras (?) daintreei*, Whitehouse (13), p. 221.

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[1] βωλίτης, a mushroom.

The re-examination by the writer of the material originally described by Etheridge senior has brought to light a peculiar problem in regard to the holotype of this species. Three specimens were figured by Etheridge—a small specimen and two large forms—but no specimen was selected as the holotype. One of the large forms was figured accurately in apertural view; but the accompanying figure (1, pl. 24, top figure) in lateral view appears to have been drawn partly from the preceding specimen and partly from a more inflated form now separated as the holotype of *B. perlatum*. Since the form figured in apertural view (1, pl. 24, left lower figure) agrees with the interpretation of *Ammonites daintreei* by all later writers, that specimen (which is now refigured) is here selected as the lectotype.

Nothing further need be added to the remarks on a previous occasion (13, p. 221) about the specific features of *B. daintreei*.

The dimensions of the lectotype are :—

123. 60. — 35
97. 46. 30. 32.

BOLITECERAS PERLATUM sp. nov.

(Plate XXVI, figure 3.)

1872 *Ammonites daintreei* Etheridge (1), p. 346, pl. 24 (in part).

1892 *Haploceras daintreei* Etheridge (6), p. 495, pl. 29, figs. 1-3 (in part).

Description.—Coiling oligogyral, subangustumbilicate. Whorls inflated with slightly convergent sides and broadly arched venter. Gradumbilicate. Test with peripheral costæ and a few intermittent constrictions. Septal suture similar to *B. daintreei*.

Remarks.—This species may be distinguished from *B. daintreei* by its less convergent sides and its more broadly arched venter.

One of the specimens which apparently was used by Etheridge in drawing his composite figure of *Ammonites daintreei* is selected and figured as the holotype of this species. Probably the smallest form figured by Etheridge (1, pl. 24, fig. 2) also represents this species, but the specimen seems to have been mislaid.

Dimensions.—Holotype : 130. 45. 32. 30.

Locality.—Hughenden (Q.M. Coll.—Holotype and other specimens).

Genus COPHINOCERAS nov.[2]

Genotype : *Cophinoceras ogilviei* sp. nov.

Definition.—Involute inflated shells with ovate whorl section, arched venter and narrow umbilicus. Test ornamented with about eight rectiradiate costæ between which are minor costæ.

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[2] κόφινος, a basket.

Remarks.—The genus bears considerable resemblance to such later desmoceratids as *Austeniceras* and *Parapuzosia*. The costæ are very like those of the group of *Beudanticeras* which includes *B. dupinianum* (d'Orb.), *B. parandieri* (d'Orb.), and *B. subparandieri* Spath, from which group it has probably developed. Indeed it might be thought advisable to include those three species in *Cophinoceras*; but, from the degree of inflation and the rather more curved costæ, they are here regarded as being more appropriately left in *Beudanticeras*.

Only the one species yet is known.

Age.—Upper Albian.

COPHINOCERAS OGILVIEI sp. nov.[3]

(Plate XXVI, figures 4 *a*, *b*.)

Description.—Coiling oligogyral, angustumbilicate. Inflated; sides convergent, venter arched, whorl-section ovate. Test thick, with about eight rectiradiate costæ, each pair of such major costæ being separated by eight to twelve minor costæ. Septal suture very imperfectly known.

Remarks.—Two specimens are known, the larger of which is taken as the holotype. The prominent straight ribs, divided into a few major costæ separated by minor costæ, render it distinct from any other desmoceratid described from Eastern Australia.

Dimensions.—Holotype: 183. 53. 33. 15.
Q.M. Coll.: 93. 56. 37. 18 (?).

Locality and Horizon.—Bynoe River, North Queensland (Q.M. Coll., holotype). Mouth of Bynoe River (Q.M. Coll.). The specimens are associated with other Tambo Series (Upper Albian) species. But since they were found both in the extreme north of the Cretaceous outcrop of the Artesian basin and nearer its presumed Cretaceous connection with the open sea, it may be that this species represents an horizon rather higher than any met with in the main area of the basin. However, in the large collection of specimens examined by the writer from the Point Charles bed (*substuderi* zone), which represents an Albian horizon slightly later than the Tambo Series, no specimen of a *Cophinoceras* has been seen.

[3] The species is named in honour of Mr. C. Ogilvie, B.E., in recognition of his important work in the Cretaceous areas of Western Queensland.

REFERENCES.

1. Etheridge, R., 1872. Description of Palæozoic and Mesozoic Fossils of Queensland (Q.J.G.S., vol. xxviii).

2. Etheridge, R. Jr., 1901. Additional Notes on the Palæontology of Queensland, pt. 2, (Geol. Surv. Q'land, Bull. No. 13).

3. Etheridge, R. Jr., 1902. The Cretaceous Mollusca of South Australia (Mem. Roy. Soc. South Aust., vol. ii, pt. 1).

4. Etheridge, R. Jr., 1902. A Monograph of the Cretaceous Invertebrate Fauna of New South Wales (Mem. Geol. Surv. N. S. Wales, Pal. No. 11).

5. Etheridge, R. Jr., 1905. Cretaceous Fossils from Dalhousie Springs (Parl. Paper South Aust., No. 71).

6. Jack and Etheridge, 1892. The Geology and Palæontology of Queensland and New Guinea (Brisbane and London).

7. Kossmat, F., 1897. Untersuchungen über die südindische Kreide-formation (Beit. z. Pal. u Geol. Ost-Ung. u. d. Orients Bd. xi).

8. McCoy, F., 1865. On the Discovery of Cretaceous Fossils in Australia (Trans. Roy. Soc. Victoria, vol. vii).

9. McCoy, F., 1865. Notes on the Cretaceous Deposits of Australia (Ann. Mag. Nat. Hist. ser. 3, vol. xvi).

10. McCoy, F., 1867. On the Discovery of *Ichthyosaurus* and *Plesiosaurus* in Australia. (Ann. Mag. Nat. Hist. ser. 3, vol. xix).

11. McCoy, F., 1868. On the Discovery of *Enaliosaurus* and other Cretaceous Fossils in Australia (Trans. Roy. Soc. Victoria, vol. viii).

12. Spath, L. F., 1923. A Monograph of the Ammonoidea of the Gault (Pal. Soc. London).

13. Whitehouse, F. W., 1926. The Cretaceous Ammonoidea of Eastern Australia (Mem. Q'land Mus., vol. viii).

EXPLANATION OF PLATES.

Plate XXV.

Fig. 1.—*Beudanticeras ingente* sp. nov. Holotype (× 0·5). From Beaconsfield (G.S.Q. Coll.).

Fig. 2.—*Beudanticeras mitchelli* (Etheridge). Lectotype (× 0·5). From Marathon (Q.M. Coll.).

Fig. 3.—*Beudanticeras flindersi* (McCoy). Holotype (× 0·5). From Base of Walker's Tableland, near Hughenden (N.M. Coll.).

Fig. 4.—*Beudanticeras sutherlandi* (Etheridge). Holotype (nat. size). From Marathon (Q.M. Coll.).

Plate XXVI.

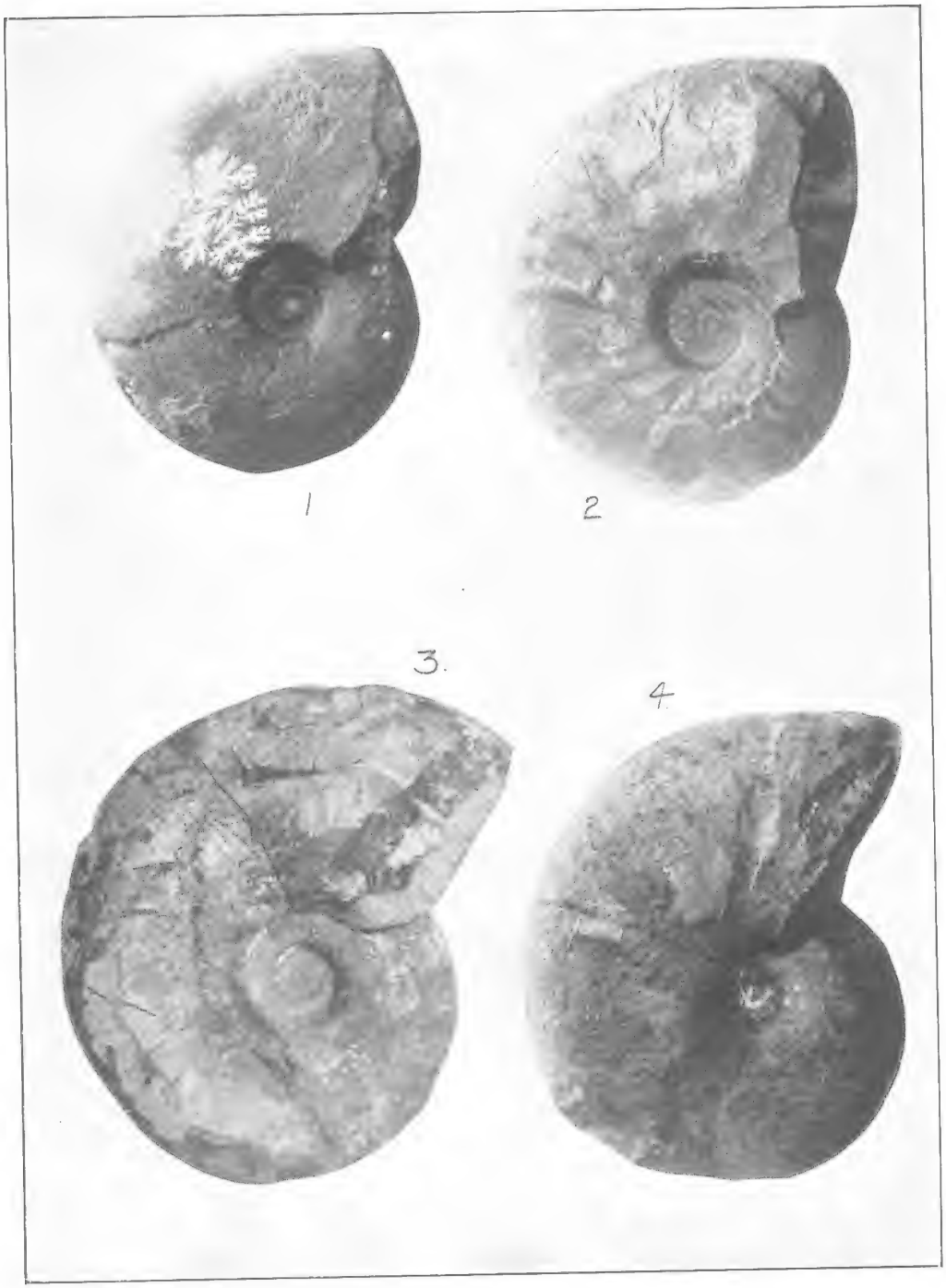
Fig. 1 (*a*), (*b*)—*Desmoceras* (?) sp. (nat. size). Specimen from Hughenden. (MM.. Coll.).

Fig. 2.—*Boliteceras daintreei* (Etheridge). Holotype (× 0·5). From Hughenden (Q.M. Coll.).

Fig. 3.—*Boliteceras perlatum* sp. nov. Holotype (× 0·5). From Hughenden (Q.M Coll.).

Fig. 4.—*Cophinoceras ogilviei* gen. et sp. nov. Holotype (× 0·5). From Bynoe River (Q.M. Coll.).

A. J. Cumming, Government Printer, Brisbane.



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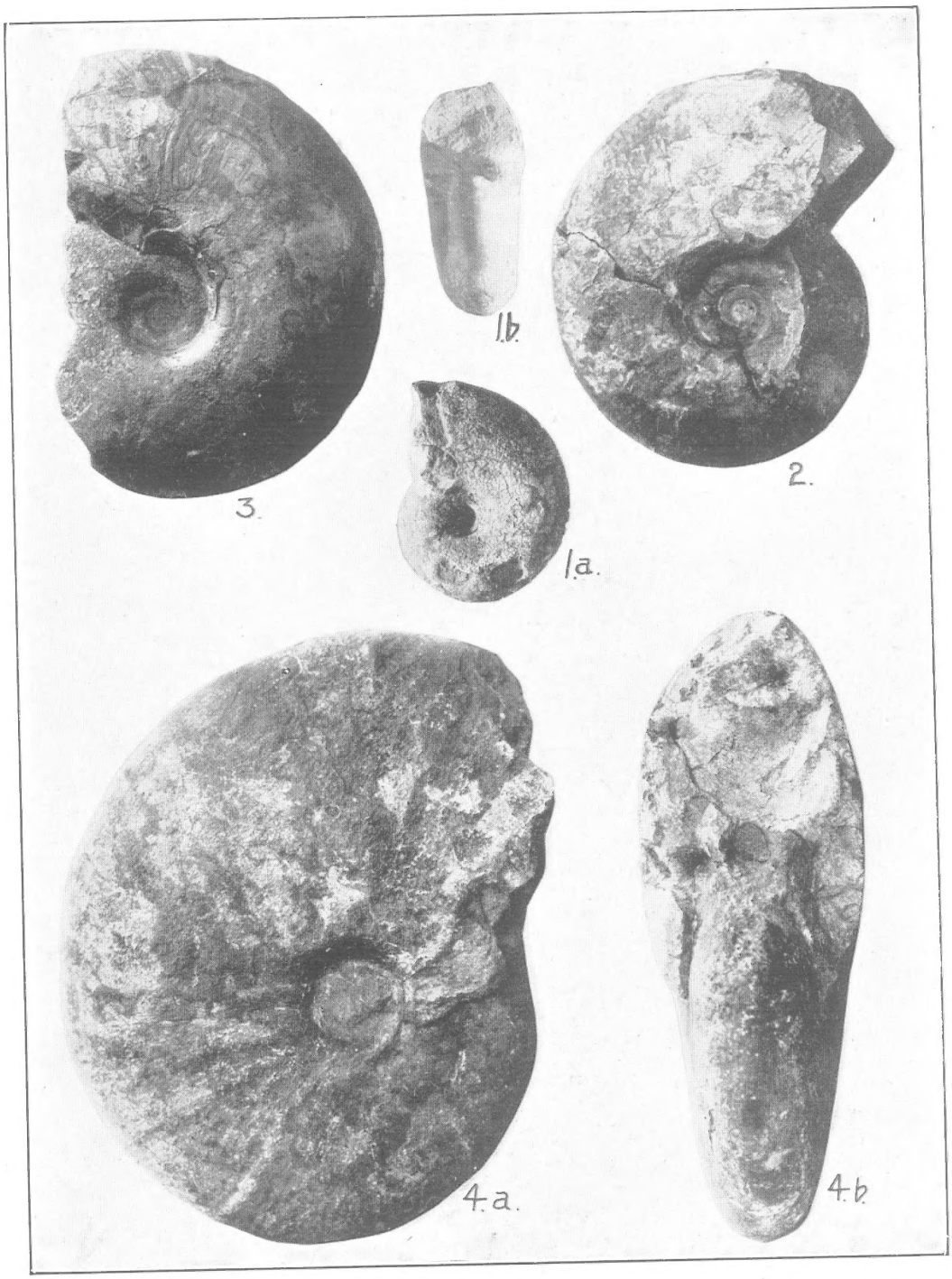

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